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Five-Masted Auxiliary Sailing Ship France

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BY F. C. COLEMAN

One of the most interesting vessels built in any part of the world during the present year (1913) is the auxiliary sailing ship *France,* constructed by Chantiers et Ateliers de la Gironde, of Bordeaux, for the Société des Navires Mixtes, of Rouen. The *France* is a five-masted ship, and is the largest sailing ship fitted with auxiliary motive power which has yet been built. The principal dimensions are:

FIG. 1.—SAILING SHIP FRANCE FITTED WITH SCHNEIDER-DIESEL ENGINES

Extreme length	430 feet
Beam	55 feet 9 inches
Depth	28 feet 2 inches
Draft loaded	23 feet 11 inches
Displacement loaded	10,730 tons
Capacity of holds	353,000 cubic feet
Carrying capacity	6,500 tons
Sail area	70,000 square feet

Built of steel throughout, to both the Bureau Veritas and Lloyd's specifications, the vessel has a forecastle, a long deck-house amidships, and an aft deck-house. Her lower deck and holds are divided for the storage of goods, while the double bottom over the whole length is arranged for carrying water ballast. There are also a fore peak and a large water tank to ensure her stability when light.

The deck-house amidships is fitted up for berthing six first class passengers and a doctor. The accommodation comprises the necesary cabins, a saloon, smoke room, reading room, photographic dark room and bathrooms, heated by steam and electrically lighted. The house aft contains the cabins for the ship's officers.

Propelling Machinery

The propelling machinery, built at Messrs. Schneider's Creusot Works, consists of two Schneider-Carels four-cylinder two-cycle internal combustion engines having cylinders 17.716 inches in diameter with a 22.947-inch stroke. During a six-hour trial on the testing-bed at the works each engine developed 925 shaft horsepower at a speed of 234 revolutions per minute. The engine-room is right aft, and each engine drives a propeller by a short shaft; the shafts are uncoupled from the engines when the ship proceeds under sail.

Details of the engines are shown in Figs. 5-8. Besides the four working cylinders, each engine has an air-compressor for fuel injection, a scavenging pump, a cooling water pump and lubricating pumps, whose speed is half the main-engine speed.

Engine Construction

The working cylinders have independent liners, and are bolted on a cast iron frame. This forms a closed-in casing, which is provided with large inspection doors, and is bolted

down upon the base plate, the latter being fixed to the keelson. Inside the frame, and underneath each cylinder, are provided guards, which allow the free travel of the connecting rod, but prevent the lubricating oil from penetrating the cylinders.

The cylinder heads are steel castings; each head is fitted with four scavenging valves, one needle fuel valve, one starting valve, and one small safety valve. The pistons are of cast iron in two parts; two of the connecting parts are hollow, and form a passage for the circulation of the oil for cooling the pistons. Besides the rings at the top end of each piston, there are two at the lower end to prevent the escape of burnt gases inside the engine frame.

The gear is operated by two shafts on the side of the engine frame. One of these, a lay shaft, driven by the engine and having the same speed as the latter, is fitted with cams for running ahead and running astern. The second shaft, a weigh shaft, located above the former, has only one set of cams; it can be operated by hand by means of a hand wheel, and serves to regulate the phases of the distribution.

The scavenging valves are operated two by two by levers driven by rods. The latter are each connected to a second lever, which is operated in the middle of its length by a cam of the lay shaft, the fulcrum being on a vertical rod having at its top part a roller, which bears constantly against a corresponding cam on the weigh shaft. Since the fuel and starting valves do not work simultaneously, they are operated by the same lever and one single rod; the fuel valve opens upwards and the starting valve downwards. Two levers, situated below and above the lay shaft, are joined on the lower end of the rods; the fulcrum of both these levers is on the same bar, which is guided in its action and is provided at its end with a roller which bears against a grooved cam on the weigh shaft.

FIG. 2.—PASSENGER SALOON ON THE AUXILIARY SAILING SHIP FRANCE

MANEUVERING

Starting is by compressed air. The weigh shaft is first revolved, and placed in such a position that the rollers of the lower levers of the scavenging and starting valves are in contact with their respective cams for running ahead, the starting valves open, and the air coming from the receivers for starting causes the engine to turn. When the engine has reached a sufficient speed the weigh shaft is operated so that, two cylinders remaining supplied with compressed air, fuel is injected in the two others; when the latter operate normally, fuel is injected in all four cylinders. The fuel supply is then regulated to give the engine its required speed.

Reversing is effected by a longitudinal displacement of the lay shaft, which brings the cams for running astern in the place previously occupied by those for running ahead; this can only be carried out when the weigh shaft is in a neutral position. When the position of the cams has thus been shifted the engine is started in the same way as obtains for running ahead. Reversing, requiring only the maneuvering of a hand wheel and a lever, is effected in a few seconds, and with a moderate consumption of compressed air.

PUMPS

The fuel is supplied to the fuel valves by four independent pumps, each of which can be cut out simply by closing the fuel supply cock. When running, the fuel consumption is regulated in the usual way by acting upon the suction valve. This valve is also under the action of the governor, which decreases the flow of the fuel gradually as the speed exceeds 230 revolutions per minute. It is open when starting on compressed air.

The scavenging pump, driven by the crankshaft, draws from the engine room, through a pipe provided with a screen, and

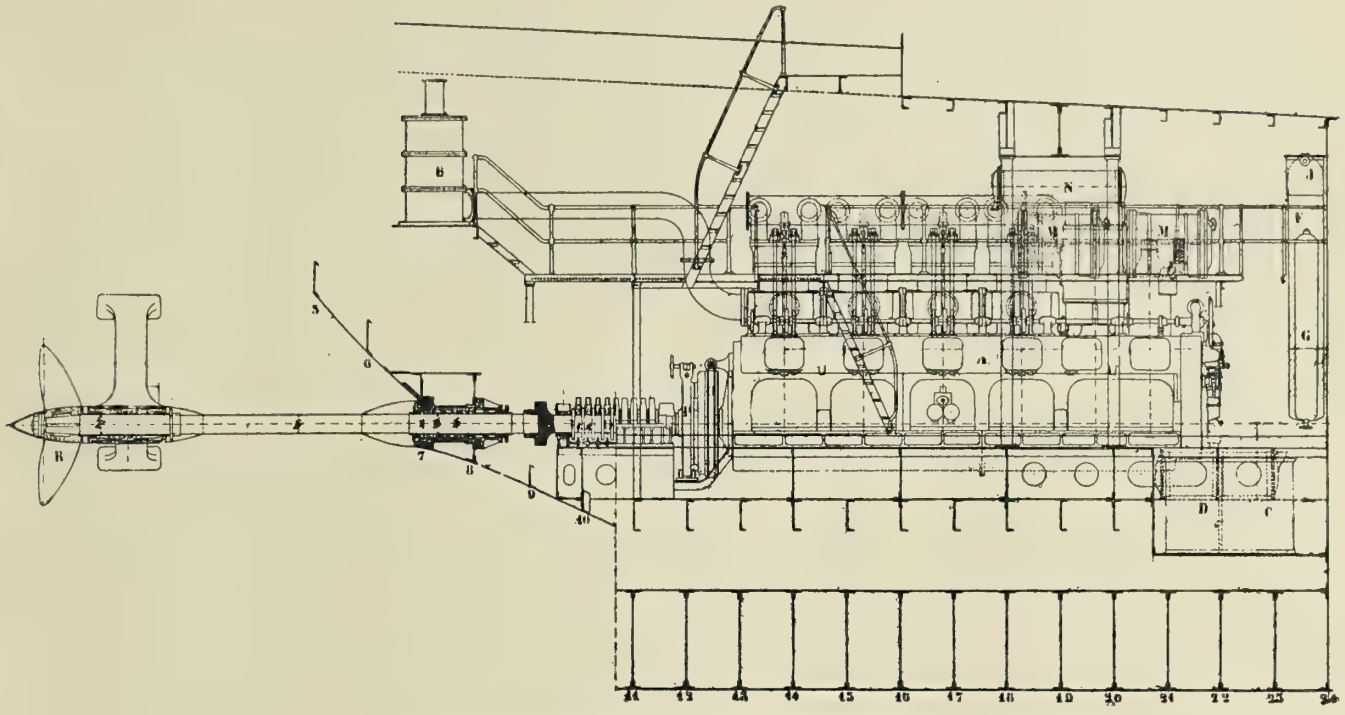
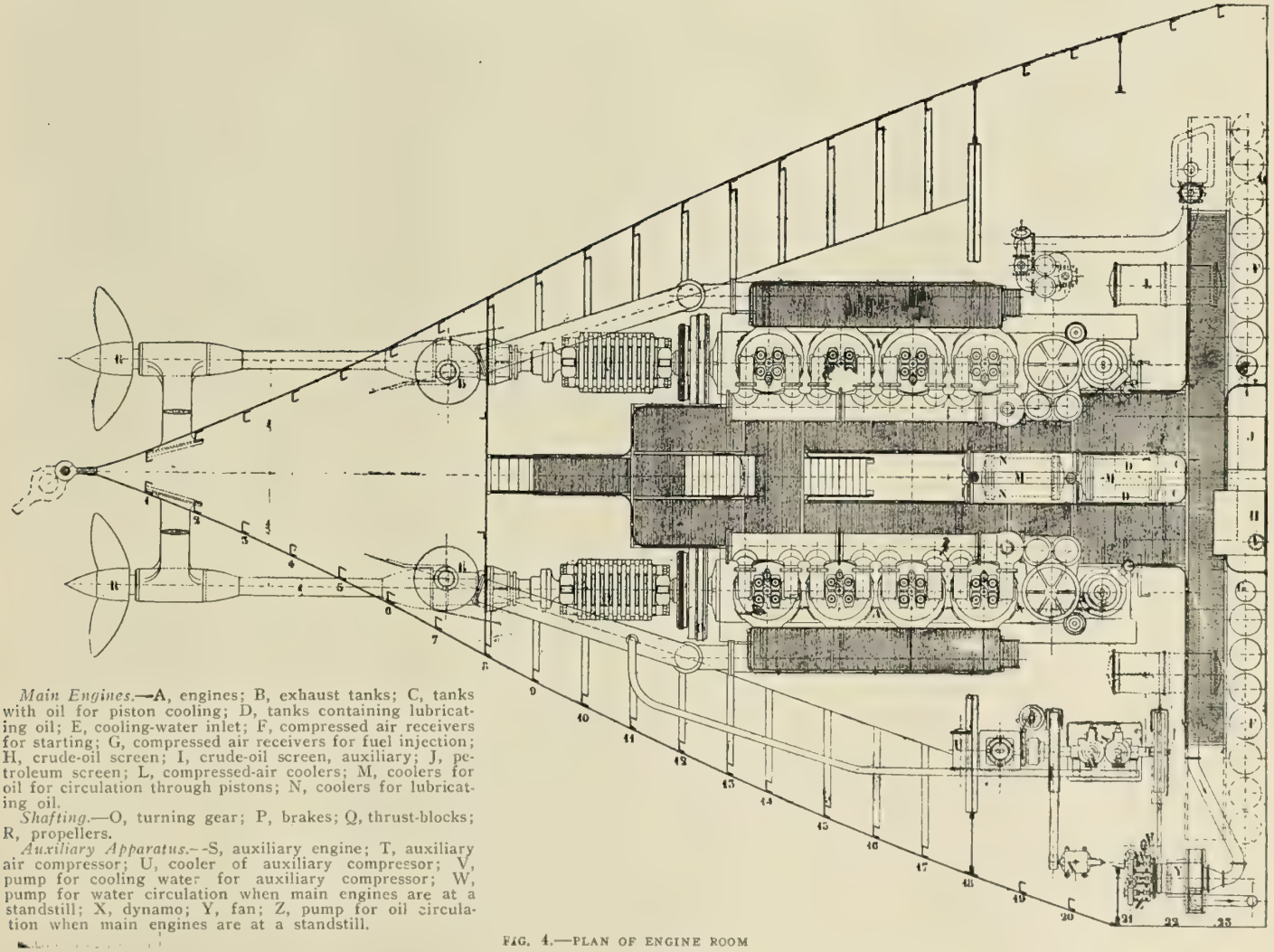


FIG. 3.—LONGITUDINAL SECTION THROUGH ENGINE ROOM



Main Engines.—A, engines; B, exhaust tanks; C, tanks with oil for piston cooling; D, tanks containing lubricating oil; E, cooling-water inlet; F, compressed air receivers for starting; G, compressed air receivers for fuel injection; H, crude-oil screen; I, crude-oil screen, auxiliary; J, petroleum screen; L, compressed-air coolers; M, coolers for oil for circulation through pistons; N, coolers for lubricating oil.

Shafting.—O, turning gear; P, brakes; Q, thrust-blocks; R, propellers.

Auxiliary Apparatus.—S, auxiliary engine; T, auxiliary air compressor; U, cooler of auxiliary compressor; V, pump for cooling water for auxiliary compressor; W, pump for water circulation when main engines are at a standstill; X, dynamo; Y, fan; Z, pump for oil circulation when main engines are at a standstill.

FIG. 4.—PLAN OF ENGINE ROOM

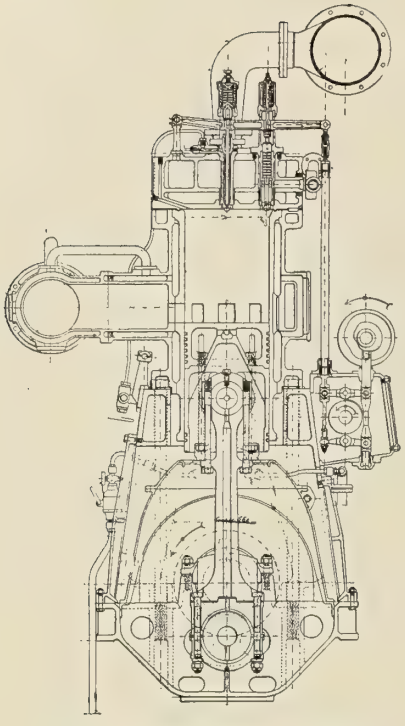


FIG. 5.—SECTION THROUGH WORKING CYLINDER

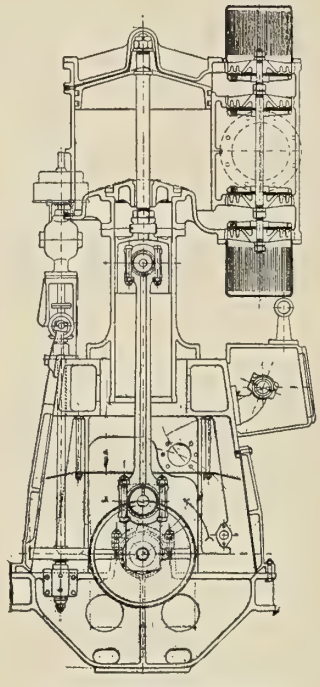


FIG. 6.—LOW-PRESSURE STAGE OF AIR COMPRESSOR

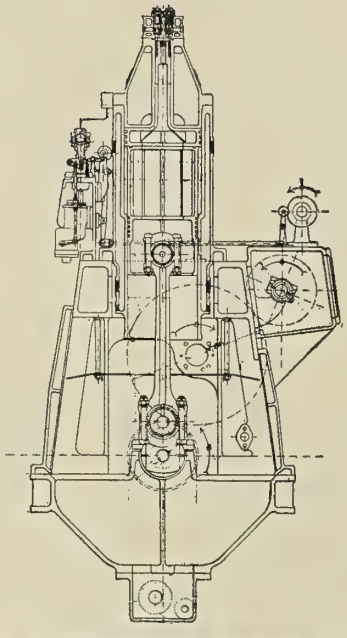


FIG. 7.—HIGH-PRESSURE STAGES OF AIR COMPRESSOR

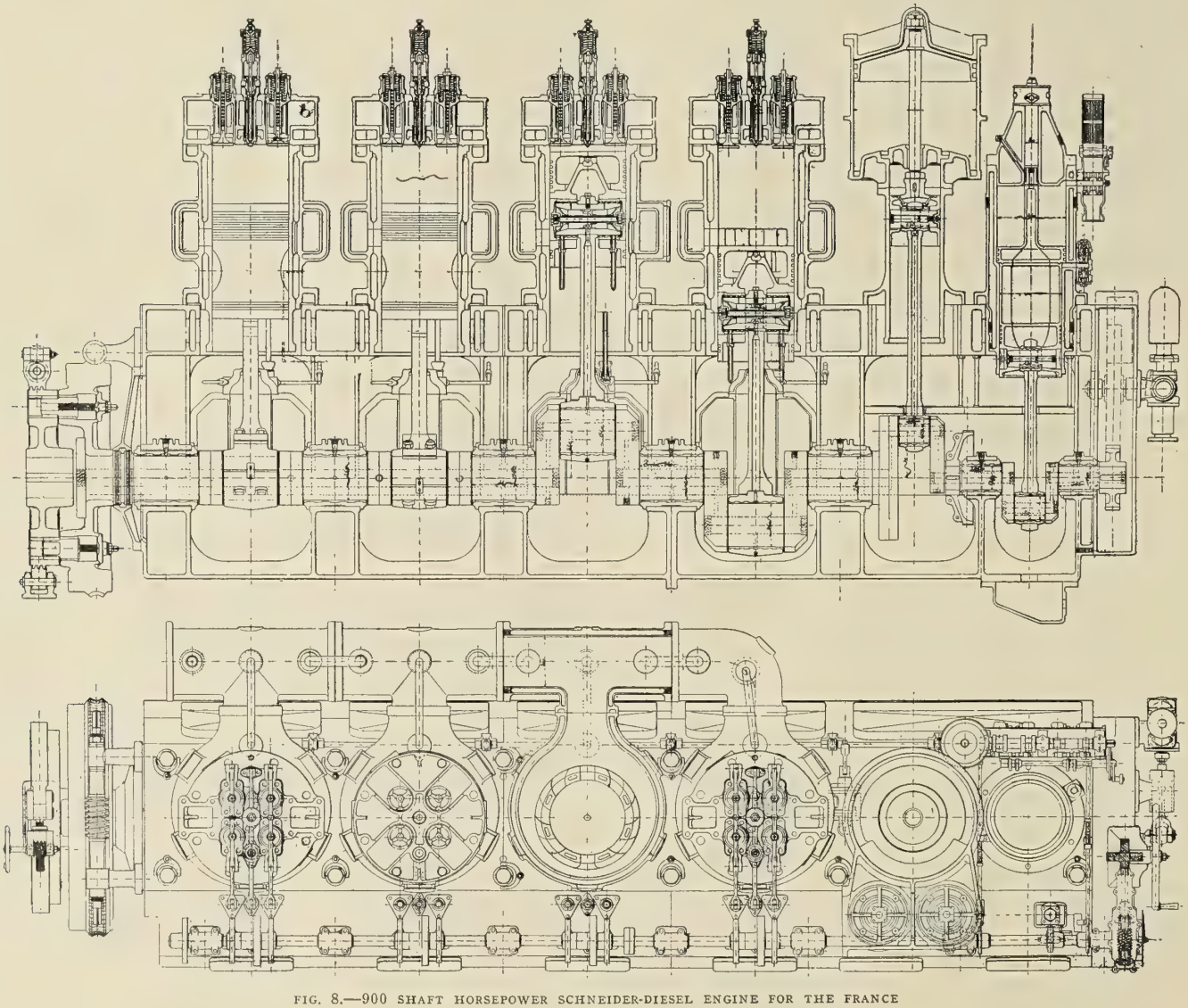


FIG. 8.—900 SHAFT HORSEPOWER SCHNEIDER-DIESEL ENGINE FOR THE FRANCE

delivers into a large capacity receiver at a pressure which varies from 2.8 pounds to 4.9 pounds per square inch, according to the speed of the engine. Suction and delivery take place through Hoerbiger metallic valves, which act satisfactorily, notwithstanding the comparatively high speed of the engine.

The air compressor for fuel injection is also driven by the crank shaft; this is a three-stage compressor, and each stage is water-cooled. The air supply to the low-stage cylinder is provided with a butterfly valve, the position of which is regulated according to the pressure required for the fuel delivery. It is opened out completely when the compressor acts at the same time for charging the compressed-air receivers for starting.

containing the lubricating oil and delivers through sight-feed lubricators at two opposite points of the piston circumference.

The water circulating pump draws from the sea through a double screen, which can be inspected while the engines are running. The water flows first through the air-cooler, and is then delivered to the two coolers for the lubricating oil and the circulating oil for cooling the pistons; it then circulates round the air compressor for fuel injection, the cylinder ends, and then runs back to the sea. The water is taken from one of the cylinder heads for heating the oil fuel by means of a coil placed in the oil fuel tank.

Fuel Supply

A set of cocks on the suction side of the pumps allows the

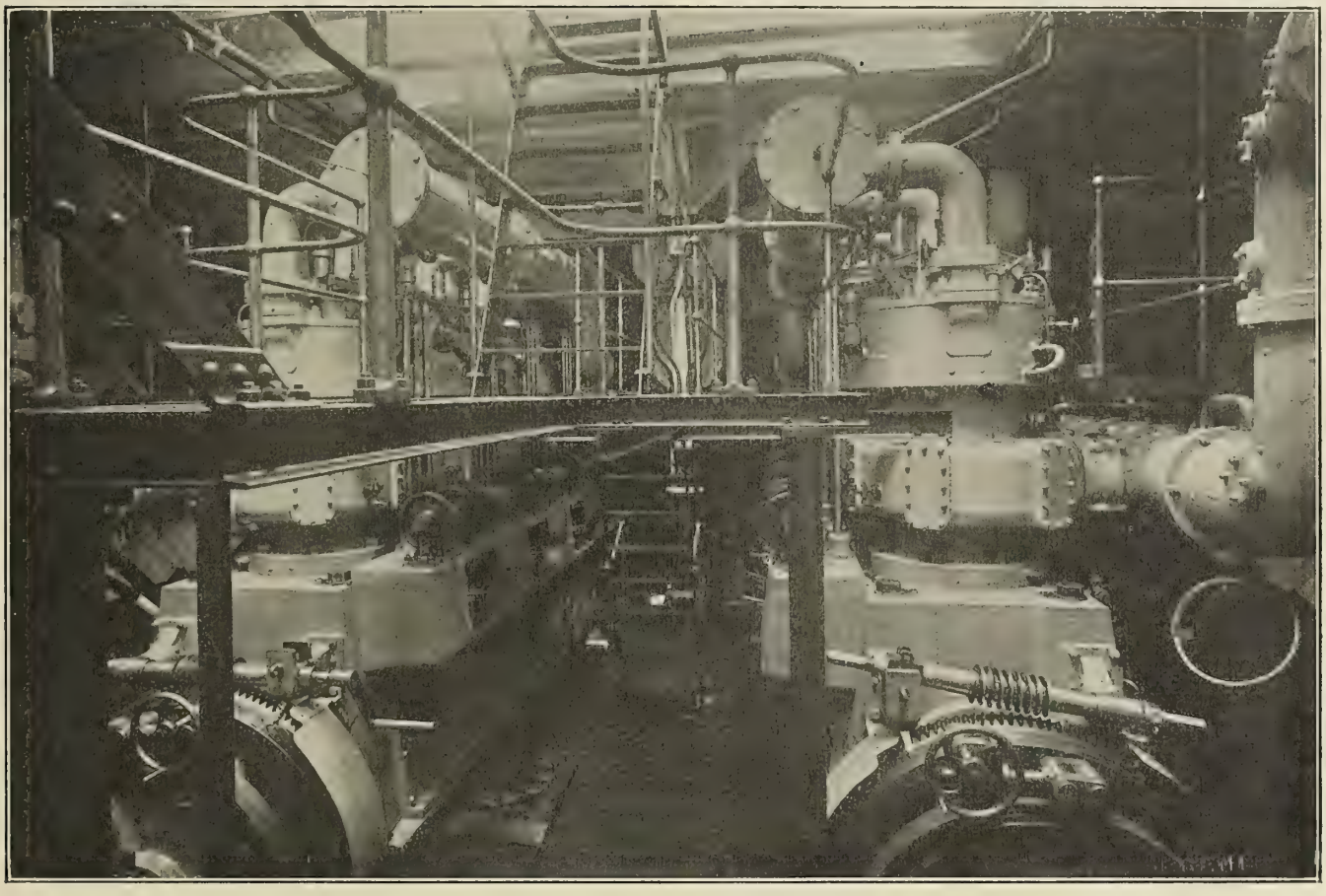


FIG. 9.—VIEW OF ENGINE ROOM, LOOKING FORWARD

Lubrication and Circulation

The lubricating pump draws from a tank located at the base of the engines. The oil is delivered at a pressure of from 2.8 pounds to 7 pounds per square inch, the pressure being adjustable by means of a valve and discharge cock, through a cooler and a double filter into a collector, which runs along the whole length of the engines. The cooling and filtering apparatus can be inspected while the engine is running. From the collector, the oil flows to all the shaft bearings and to all the connecting rod brasses. The oil runs from the casing back to the tank. The pump for the oil circulation through the pistons draws from another tank and delivers, as in the instance of the former pump, into a collector, whence the oil is distributed to the pistons by means of telescopic tubes; it then flows through pipes back to the tank. When the engines are standing, the oil circulation is ensured by a hand pump or by a centrifugal pump driven by an auxiliary engine. The piston lubrication is effected by one single pump driven by the indicator shaft; it draws from the collector

engines to be supplied either with lamp oil or with crude oil; the former is used for starting the engines when the cylinders are cold. The crude oil is contained in holds in the ship's bottom, whence it is drawn, either by a hand pump or, when the engines are running, by a small reciprocating pump driven by the main engines, and delivered through a filter into a tank placed above the engines, and where it can be heated by the circulating water proceeding from one of the cylinder heads as above stated. From the tank the oil fuel flows to the suction boxes of the oil fuel pumps. A second, auxiliary, filter is provided, and can be put in the oil fuel circuit for the purpose of enabling the main filter to be cleaned without stopping the engines. Two tanks containing the lamp oil, each having a capacity of 350 cubic feet, are located on deck. From these the lamp oil flows through a filtering tank before running to the suction boxes of the pumps.

Both engines exhaust into a collector, which is water cooled as far as the silencer; this is cylindrical in shape and contains baffle plates for deadening the noise of the exhaust. A

pipe starts from each silencer and ends outside the hull right aft. The pipes are fitted with valves to prevent water entering them in bad weather, when the engines are not running.

The compressed air receivers for starting the engines are four in number, and have a total capacity of 113 cubic feet. They can be charged at a pressure of 995 pounds per square inch; the air pressure for starting is brought down to 497 pounds per square inch, maximum, through a reducing valve on the engines. The compressed air for the oil fuel injection is contained in two receivers, having each a capacity of 3.9 cubic feet. All the movements for starting the engines, reversing, regulating the fuel supply, regulating the pressure of the circulating oil, etc., are carried out from one single stand in front of each engine. The auxiliaries are driven by a Millot four cycle lamp oil engine, of 25 horsepower, at a speed of 330 revolutions. They include a two-stage air compressor for charging the compressed air receivers in the first instance, a dynamo supplying current for lighting, a fan in the engine room, and oil and water centrifugal pumps for cooling the engines when these are at a standstill.

The total weight of the engines, including shafting, flooring, and auxiliary apparatus, is equal to about 158 pounds per shaft horsepower.

TRIALS

The trials at the works consisted of a six-hours' run of each engine at full power, on lamp oil, and of a sixteen hours' run at two-thirds load of one engine on Autun shale-oil.

The full-power trials gave the following results:

Average speed, revolutions per minute.....234
Mean pressure of diagram.....100 pounds per square inch
Corresponding indicated horsepower.....1305
Shaft horsepower (on brake).....924
Mechanical efficiency.....0.707
Petroleum fuel consumption reduced to standard fuel of 10,000 calories per kg.:
Per indicated horsepower hour, .329 pound
Per shaft horsepower hour, .642 pound
Oil consumption (lubricating) per shaft horsepower.... .012 (British)
Oil pressure for lubricating.....4.9 pounds per square inch
Oil pressure for piston cooling....35.5 pounds per square inch
Water pressure.....17.7 pounds per square inch
Scavenging pressure.....5.1 pounds per square inch
Fuel inlet pressure.....796.5 pounds per square inch
Oil temperature:
For lubricating:
Before entering cooler.....102 degrees F.
After entering cooler.....98 degrees F.
For cooling piston:
Before entering cooler.....204 degrees F.
After entering cooler.....154 degrees F.
Temperature of cooling water, inlet.....46 degrees F.
Temperature of cooling water, outlet.....98 degrees F.

A four hours' trial run of the ship with the engines alone took place off La Pallice, using lamp oil; this was followed by a six-hours' run, using crude oil—the fuel provided for her ordinary service. The contract speed was 10.05 knots. The speed at these trials was 10.3 knots, or a quarter of a knot above the contract speed.

The ship is provided with an auxiliary steam boiler, a steam windlass, a steam and hand steering gear, and steam winches.

SERVICE

The *France* has been chartered for three years to transport minerals from New Caledonia to France, and she has recently started on her maiden voyage. It is expected that from 50 to 60 days will be required for the voyage, a saving of at least 30 days on the best passages under sail power alone.

This big five-master, when under a good pressure of canvas and with her twin engines going, is expected to be able to do 17 knots; and in calm weather, when progress through the water is obtained purely by her oil engines, it is expected that she will have a speed of about 10 knots.

Annual Report of Lloyd's Register of Shipping for the Year 1912-1913

At the close of the year ended June 30, 1913, 10,466 merchant vessels, registering over 22,500,000 tons gross, held classes assigned by the Committee of Lloyd's Register. During the year the committee assigned classes to 651 new vessels. Their registered gross tonnage amounted to 1,664,667 tons, which is the highest figure for one year ever recorded in the history of the society. Of the 651 new vessels, 593 represent steamers of 1,643,250 tons and 58 sailing vessels of 21,417 tons. Of the total, 1,010,876 tons, or about 60½ percent, were built for the United Kingdom, and 653,791 tons, or about 39½ percent, for the British colonies and foreign countries. During the twelve months ended June 30, 1913, plans of 752 vessels representing 2,000,000 tons of shipping were passed by the committee; and at the end of September the new tonnage actually in hand under the special survey of the society reached the total of 2,048,136 tons.

MOTOR SHIPS

At the present time there are in service twelve sea-going vessels classed with this society which are propelled by Diesel engines, and there are twenty-five others being built under the inspection of the society's surveyors. The motor ship *Fordonian,* after some preliminary trouble with her auxiliaries, made a non-stop run of twenty-six days' duration from the Clyde to Quebec. This vessel is now engaged on ordinary service on the Great Lakes of North America, and appears from the latest reports to be giving complete satisfaction. The *Hagen* made a voyage to New York and back, but experienced some difficulty with her auxiliaries on the return voyage. In both these cases the main engines were satisfactory.

The motor ships *Suecia, Pedro Christophersen, Siam* and *Annam,* as well as the *Selandia* and *Christian X,* previously built by Messrs. Burmeister & Wain, are giving satisfaction in their ordinary service. These builders have now in hand at Copenhagen and at Glasgow twenty-three sets of Diesel engines for fourteen vessels to be classed by Lloyd's Register. It should be mentioned that with further experience of these engines, increased economy has been effected, and the improvements have been such that they have also been applied to the older vessels. The confidence which has been obtained as a result of the successful working of the earlier vessels has led the builders to reduce the number of cylinders in the later designs from eight to six per shaft, and at the same time to make the cylinders of such larger dimensions that a considerably higher power will be developed upon each shaft.

It may also be mentioned that the motor ship *Juno,* as well as the *Vulcanus,* referred to last year, engined by the Nederlandsche Fabriek van Werktuigen en Spoorweg-Materieel, and managed by the Anglo-Saxon Petroleum Company, has proved so satisfactory in service that the owners have put them to work in their local trade in the East. In addition, these builders have now in course of construction at Amsterdam, eleven sets of Diesel engines for six vessels to be classed with this society.

In some vessels fitted with Diesel engines there have been minor difficulties with details, such as pistons, cylinder covers, etc., but these appear to have been overcome. It was only to be expected that in the early stages of the application of these engines to sea-going purposes some troubles would arise. As the number of engines increases and experience accumulates there will doubtless be a general improvement in the designs of details, which will thus be made more reliable to withstand the very severe conditions of high temperatures combined with

the heavy stresses they have to endure. This desirable end would be facilitated by a frank interchange of the individual experiences of those interested in this type of engine.

Of the twenty-five Diesel-engine vessels building, referred to above, six are to the order of the Anglo-Saxon Petroleum Company and seven for the East Asiatic Company, of Copenhagen. It is interesting to observe from the latest published report of the latter company that they have also arranged to replace by Diesel engines the present steam engines of three of their vessels. These steam engines will be fitted in three other vessels building for them, which will be engaged in a trade where it will be profitable to use coal instead of oil, but for which trade the present three steamers are not suitable.

Size of Vessels

A feature which stands out very prominently in the operations of the society during the twelve months ended June 30, 1913, is the unprecedented number of vessels of upwards of 5,000 tons which have been assigned the 100A1 class. During the period in question no fewer than 120 such vessels have been classed. The latest returns of vessels being built to the society's classification show the same tendency towards the construction of vessels of large tonnage. The returns include twenty steamers of 12,000 tons and above. There are also numerous steamers of 10,000-12,000 tons each being built to the society's classification.

During the period under review plans have been approved for vessels of many types, including a coast-guard cruiser, a non-propelling rock-cutter barge, a pumping steamer for land reclamation, a steel screw lightship, and a train ferry for service between Quebec and Levis, besides other vessels for channel and river service and various coasting trades, as well as dredgers, barges, motor launches, etc.

The launch of the Cunard Company's quadruple screw turbine steamer *Aquitania,* 48,000 tons gross, from the yard of Messrs. John Brown & Company, at Clydebank, was an event of unusual interest during the year. In this steamer, the largest British vessel afloat, special attention has been given to an extensive system of subdivision by means of watertight bulkheads and flats, whereby she is rendered practically unsinkable.

Special Types

The number of vessels built and building upon the Isherwood system of longitudinal framing has largely increased during the last twelve months. Up to the end of June, 1913, 116 such vessels, representing 552,845 tons, had been assigned the society's classification, and there are now in course of construction under the inspection of the society's surveyors eighty-five of these vessels, registering 451,344 tons—altogether a total of 1,004,189 tons.

The year under review has witnessed a remarkable increase in the amount of tonnage classed by the society in respect of vessels intended for carrying oil in bulk. During the twelve months ended June 30, 1913, no fewer than forty-five such vessels, of 202,005 tons, received the society's classification. The demand for vessels of this description still continues, and there are at the present time eighty-three of these vessels, of 381,410 tons, preparing and in course of construction under the supervision of the society's surveyors.

The consumption of imported frozen and chilled meat, dairy produce, etc., is increasing yearly, and the question of the oversea carriage of such cargoes is one which has always received the closest attention of the committee, who view with much satisfaction the continued confidence which shipowners, underwriters and merchants place in the surveys carried out by the society's surveyors of the refrigerating machinery and appliances employed. The number of vessels holding the society's certificate in respect of refrigerating machinery (Lloyd's R. M. C.) continues to increase, being now 171. At the present time there are twenty-five vessels being fitted with refrigerating machinery under the supervision of the society's surveyors, the majority of them being of very large carrying capacity.

The use of wireless telegraphy and submarine signaling increases year by year. There are now recorded in the society's register book 1,932 vessels fitted with wireless telegraphic installations as compared with 1,392 at a corresponding date last year, and 806 fitted with submarine signaling apparatus as compared with 630 last year.

The number and gross tonnage of yachts classed in the society's register of yachts are 701 yachts of 115,599 tons. Of these, 292 of 100,968 tons are steam yachts and 339 of 9,103 tons are sailing yachts, while seventy of 5,528 tons are fitted with internal-combustion engines.

Panama Canal Tolls

In the November issue of International Marine Engineering, page 466, we referred to the manner in which the United States Government has woefully bungled the subject of tolls in the Panama Canal. Our statement, after criticizing the Government caustically, ended in the following sentence: "The action taken by the United States Government is a serious reflection upon American engineering ability and a great step backwards in these days of scientific attainments."

Many correspondents have asked us to state more fully the reasons for the position we have taken. We herewith answer all of these correspondents as concisely as possible.

Discrepancies of Net Tonnage Measurement

The assessing of tolls for traffic through the Panama Canal, as well as for port charges or for dry dockage, on the basis of net tonnage, is more or less farcical, for the following reasons:

1. Net tonnage bears no direct ratio to the actual size of the vessel, as it varies with nearly every type of craft, owing to the fluctuating deductions of space for machinery, crew and passengers.

2. It is not based on calculations sanctioned by any universally adopted standard.

3. It is not capable of being checked readily by the representatives of any government or parties interested in collecting charges for services rendered.

4. At the best no two persons can calculate it exactly alike, as the fundamental rule (Simpson's) upon which the areas of such irregular figures as the various sections of a ship must be calculated is in itself empirical.

5. Fast passenger ships, steam yachts and other special types of ships have a decided advantage over slow freight ships, the principal carriers of bulky cargoes by sea, inasmuch as the total deduction from their gross tonnage is greatly in excess of that allowed the full-lined slow ships.

6. In the proposed system of levying tolls for the Panama Canal a fixed charge per net registered ton is presented for loaded vessels and a fixed proportional amount is presented for each net registered ton when the vessel is light. This in itself is a tacit acknowledgment of the inadequacy or lack of flexibility of the "net tonnage" system. If a vessel is partly loaded, as often happens, the question will arise at once as to whether the toll is to be assessed at "loaded" rates or at "light" rates. Who, under the prescribed rules, can decide this matter equitably?

The advocates of net tonnage contend that it is equitable because only the earning capacity of a ship is taxed. It is claimed that in these days the net tonnage is measured by uniform rules throughout the world, yet an investigation of the fact develops that such is not the case. For example, it is stated in the report of the Commissioner of Navigation for 1911, in speaking of Panama Canal tolls:

"After deductions have been made the balance on net tonnage represents the assessable tonnage of a ship. Subject to the qualification suggested it may be said, roughly, that at the

rate, for simplicity, of one dollar a net ton, one hundred gross tons would pay charges at Suez, Panama, New York or Liverpool of $61.00 (12/14/2) as the world's average net measurement, and the British and German average net measurement goes, of $66.00 (13/15/0) as the American average net measurement goes, and $72.00 (15/0/0) as Suez average net measurement goes."

Here, then, is a striking illustration that net measurement is not uniform throughout the world. A difference of $11.00 (2/5/10) on one hundred gross tons for different systems of measurement at present existing does not indicate any uniformity whatever. The discrepancy in this tonnage tax comes from the practice on some vessels of carrying cargo on deck. What are known as shelter decks, in which cattle have been carried many years, have not been uniformly assessed as cargo space except for passage through the Suez Canal. The United States Government does not include this in the tonnage space, and it is not known whether it will be included in the taxed space for passage through the Panama Canal.

A further illustration of the discrepancy is instanced by the Commissioner of Navigation when he makes the statement that where the German law permits a deduction of 37 percent in fixing the assessable tonnage, the Suez regulations allow a deduction of only 30 percent for these vessels. In calculating the tonnage on large vessels the space between the inner and outer bottoms is deducted from the gross tonnage. There is nothing to prevent a vessel carrying fuel oil in this space and thus avoiding tax on this very large space in most steamships. The fixed bunker space on seagoing vessels is deducted from the gross tonnage, but for short voyages what is there to prevent carrying cargo coal in the bunker space?

In France, subsidy and navigation laws are based on *gross* tonnage. This leads shipowners to seek the largest possible gross tonnage, while they join others in favoring the lowest possible net tonnage on which tolls, taxes and port charges are based in other countries.

A tabulation has been made by the Commissioner of Navigation as to the average deductions made by various countries for net tonnage. These show a variance from a minimum of 34 percent for the United States to a maximum of 47 percent for Roumania. The average for all nations is 39 percent.

Proposed Block Unit System

This system contemplates fixing the tolls at a definite rate of so much per unit, of the ultimate product of the length on the waterline, multiplied by the breadth of beam, and that in turn multiplied by the maximum draft of the vessel at the time she enters the canal.

For example, a vessel enters the canal, and very quickly it is ascertained that she is 300 feet long on the waterline, 40 feet beam, and has a maximum draft of 21 feet 6 inches. The procedure would be simply to multiply these dimensions together, thus, $300 \times 40 \times 21\frac{1}{2} = 258{,}000$. At one cent (½ d.) per unit this would make the toll charge $2,580 (537/10/0). At this rate of one cent (½d.) per unit, it will be found that the charge will about equal that of $1 (4/2) per net registered ton for the average steamer.

This system is the acme of simplicity and equity, for the following reasons:

1. Every vessel passing through the canal is assessed on a uniform basis.

2. The three dimensions represent the space the vessel occupies in the canal and locks at the time of passage. This space is limited, and should be charged for in direct proportion to the amount of it that is used by each passing vessel.

3. The toll can be calculated by the representative of the Government in a very few moments; the captain of the vessel can witness the calculation and be satisfied that he is being charged the right amount.

4. The draft element in the calculation assures that the vessel is only being charged for the exact amount of cargo that is aboard at the time. If the vessel is "light" no charge is made for cargo, of course; if in any degree loaded the charge is automatically fixed in proportion to the load.

5. The comparative advantage of this system is all in favor of the slow low-priced freighter, so that such bulky necessities of life as coal, lumber, etc., will pass through on the smallest canal charges, owing to the fullness of the lines of the slow carrier. Passenger vessels, vessels carrying high-priced freight, such as fruits and wines, steam yachts, etc., will pay relatively higher tolls owing to their finer lines.

Ferry Boat South Jacksonville

The steel ferryboat *South Jacksonville,* illustrated on page 513, was built a short time ago by the Merrill-Stevens Company, of Jacksonville, Fla., for the Jacksonville Ferry & Land Company. It was a repetition order from this company, and in several features an improvement upon former boats built for them. In fact, the new features have proved of such advantage to the service that it is the intention to alter an older boat so as to incorporate these improvements in it.

The new ferry runs between Jacksonville and South Jacksonville, thus connecting Jacksonville with St. Augustine and the surrounding country to the south. The most important highways into Florida lead through Jacksonville, and much of the traffic over them crosses the St. Johns River at this point. During the tourist season the traffic over these roads is very heavy, and in addition there is a heavy local traffic of trams and heavy trucks to and from large factories located across the river. The *South Jacksonville* was built especially to meet the requirements of this very important traffic.

Figs. 1 and 2 show the profile and 'midship section of the boat. The principal dimensions are as follows:

Length over all	153 feet
Length between perpendiculars	130 feet
Beam over all	42 feet
Molded depth	12 feet 3 inches
Full load draft	8 feet

The form of this hull is a copy of the wooden ferryboat *Duval,* which was built for this company about eight years ago by the Merrill-Stevens Company. Although it was somewhat of an experiment with the builders at that time it has proved such a success that when the order was placed for this new and larger boat the builders did not hesitate to adopt the model of the old boat with such slight changes as experience and difference in material made desirable; the main changes from the old boat being the superstructure, which will be referred to later.

As will be seen, the 'midship frames form in the main an inverted equal-sided triangle with the apex down at the keel and the base formed by the crowned deck beams, of which there is one for each frame, and all riveted strongly together with large gusset plate connections. Two lattice girders, spaced far enough apart to give room for the boilers, run practically the full length of the hull, and not only assist in transferring the deck load to the bottom frames but also distribute the heavy concentrated loads caused by the large loaded auto trucks commonly used in this district. This deck load is further taken care of by suitable angle struts connecting the deck beams with the frames below. Three transverse bulkheads give additional stiffness to the hull.

The keel is made from an inverted channel, with the web forming the bottom of the keel, to which each frame is strongly riveted by angle connections. The bottom plating is flanged and riveted to the channel flanges. The sections of the keel are all welded together, thus adding materially to its strength.

As will be seen in Fig. 2, the bottom is further stiffened at

each frame by a plate web, the top of which is reinforced by a reverse angle supporting two rows of heavy channels, which not only distribute the load of the engine and boilers but also carry the thrust and spring bearings.

As shown in Fig. 1, there are two propellers and two stern posts, one at each end of the boat, which support the outer end of the tube encasing the propeller shafts at these points, and also support overhanging bearings of liberal length that take the weight of the propellers. The steel forgings forming these stern posts are run out aft at the bottom, forming the bottom bearings for the two partly balanced rudders. The vertical arms of these stern forgings are strongly riveted to the ends of the keel. Each propeller shaft tube is provided with the usual stuffing boxes, which are placed far enough inboard to be easily accessible.

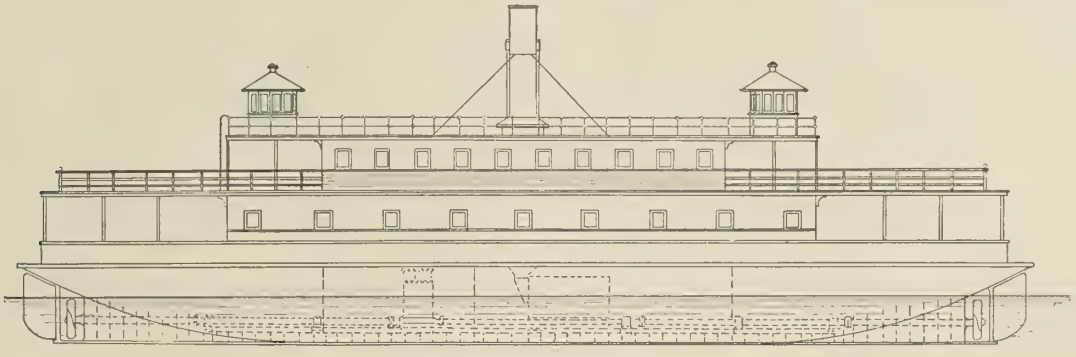


FIG. 1.—PROFILE OF FERRY BOAT SOUTH JACKSONVILLE

There are two Scotch boilers with corrugated furnaces, built for 140 pounds pressure, placed alongside of each other in heavy steel saddles built up of plates and angles. As will be seen in Fig. 2, the shape of the hull lends itself admirably for the installation of large-size boilers, and still gives room for the propeller shaft running past in such a location that it could be floored over, thus forming no obstruction to the convenient firing of the boilers. The boilers are so placed that the stack is located amidships.

The engine is of the vertical two-cylinder, double-acting type 18 inches by 20 inches. Both cylinders are for high-pressure steam with rocking valves, operated by a Hackworth type valve gear. Within easy reach is the lever operating the throttle valve, which is of the balance type. All wearing surfaces are of liberal size. The A frames supporting the cylinders are exceptionally heavy and rigid, and still give easy access to all the moving parts. The connecting rods are steel castings, with split bronze-lined stub ends at the crank end, the other ends being forked to take the wrist pin. This engine is rated at 400 horsepower, using steam at 100 pounds pressure.

A very important feature of this boat is the arrangement of the superstructure. This, as will be seen, consists of a saloon deck running practically the full length and width of the main deck and a shorter and narrower hurricane deck covering the cabin located amidships, and upon which are located the two pilot houses. The entire main deck is given over to vehicular traffic, while the passenger accommodation is located entirely on the saloon deck above, where there is ample seating capacity for the large number of people who daily cross the river during business hours.

The main deck has four tracks for automobiles and teams separated by heavy timber rails. A very important feature is that the well, forming space for the smokestack and the engine, and at each end also encloses the stairways to the upper decks, is kept down to a minimum not only in width but also in length. The result is that the curves of the tracks are very easy at both ends of the boat, materially reducing the chances of damage to vehicles.

The support of the superstructure at the center of the boat is made up of two steel cantilever trusses, one over each side of the well and at these places supported by two rows of angle and channel columns, forming a framing around this well. The sides of the well are sheathed only part of the way up, giving ample ventilation for the engine and boiler rooms. The main supports of these trusses are two latticed columns, placed far enough in so as to not interfere with the easy curves of the tracks. These columns run all the way up so as to take the weight of the pilot houses and the steering stands, and they also form convenient enclosures for the steering connections, speaking tubes and bell connections from engine room to pilot houses.

The stairways leading from the main deck to the superstructure are mainly for the use of the crew and for use of passengers in case of emergency, but they are occasionally used by the occupants of automobiles who wish to leave their cars while crossing to get a good view of the river.

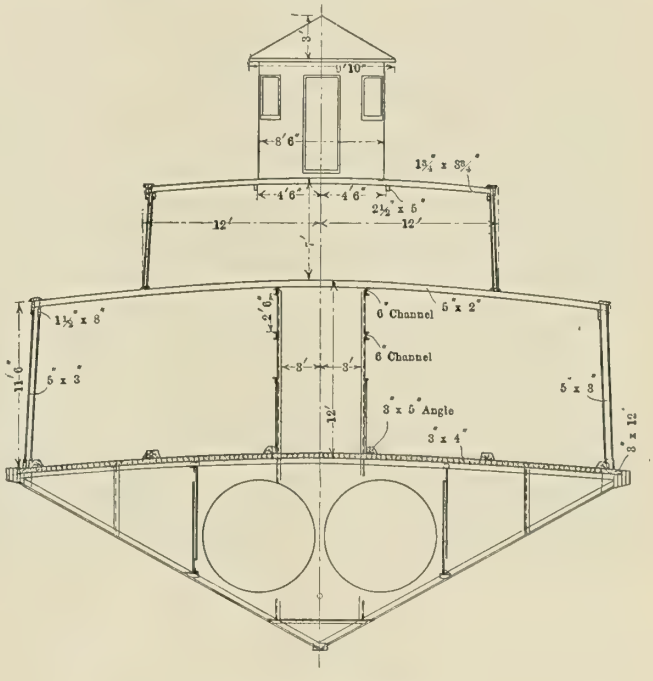


FIG. 2.—MIDSHIP SECTION

Each end of the saloon deck is built out in the form of two bridges, one at each side of the boat, and protected by gates. At the landings these bridges connect with similar bridges at the second story of the station. On landing, one bridge forms the exit and the other the entrance for passengers, thus allowing entire separation of passenger and vehicle service. The consequence is that this boat not only gives a maximum of space to the important automobile and truck service, but the transfer can be accomplished in a minimum of time, thus giving more frequent service during rush hours. It is this feature that the owners now want incorporated in their

older boat, so as to be better able to take care of the constantly growing traffic. Another very important feature of this arrangement is the less chance of accident to passengers.

The *South Jacksonville* has a speed of 12 miles per hour when running free, and can reverse direction at full speed in less than one and one-half lengths. That she has been making a regular schedule of 15 minutes per round trip on a route 2,300 feet long, with terminals not opposite, is evidence of her handling power.

The hull, boilers and engines were designed by Mr. A. D. Stevens, president and naval architect of the Merrill-Stevens Company, to whom also is due the credit for the novel design of the hull and the arrangement of the main deck, the superstructure and the manner in which the ferry company now handles its passenger service.

Turbo-Generator Sets for the Great Northern Steamship Minnesota

The success of the steam turbine for driving auxiliaries on board ship has again been proved by a recent installation of turbo-generators on the Great Northern Steamship Company's transpacific steamer *Minnesota*. This ship is the largest and most luxuriously fitted steamship on the Pacific, and it will be recalled was built at New London, Conn., about ten years ago. She is 630 feet long by 73 feet beam, with a displacement of 33,000 tons.

Electricity is used extensively, not only for furnishing light, but also for driving the cargo winches and the steering gear. The passenger accommodations are heated and ventilated throughout by electricity. Current has been supplied by 75-kilowatt vertical compound engine sets, located on a flat at the forward end of the engine room, each set with a fore and aft shaft. The lighting circuit is 125 volts, and the power circuit 250 volts. It was the custom when at sea to run three generators—one for the lighting load and two for power.

The space occupied by these sets was cramped, and, furthermore, was open to the full temperature of the engine room. The arrangement of the old installation is shown in Fig. 1, looking across the starboard room and forward. Any repairs to the engines, such as broken crankshafts, required dismantling of the entire unit, as there was no head room over the cylinder and steam chest. Furthermore, partly because of inaccessibility these sets were a constant source of trouble, and one or more of them was frequently out of commission.

When it was decided to replace the sets, the advantages of the steam turbine were carefully considered, and finally the order placed with the Terry Steam Turbine Company, Hartford, Conn., for three 100-kilowatt, 2,200 revolutions per minute Type MC turbines, direct connected through flexible couplings to Crocker-Wheeler 125/250-volt, three-wire compound wound generators. One of these units is shown in Fig. 3 and the installation is shown in Fig. 2.

The difference in space occupied between the 75-kilowatt engines and the 100-kilowatt turbines is clearly seen by comparison of Figs. 1 and 2. The floor space of the engine sets was 12 feet by 5 feet 6 inches, while the over-all height was 8 feet. The Terry turbine sets measure 10 feet long by 4 feet 5 inches wide by 5 feet 3 inches high. All parts of both turbine and generator are readily accessible to the engineer. The generator armature and shaft may be removed without disturbing the turbine, by disconnecting the coupling, raising the bearing caps and taking off the top of the frame. Similarly, the turbine casing is split horizontally, and the rotor can be removed by taking off the cover of the casing and bearings without disturbing the generator.

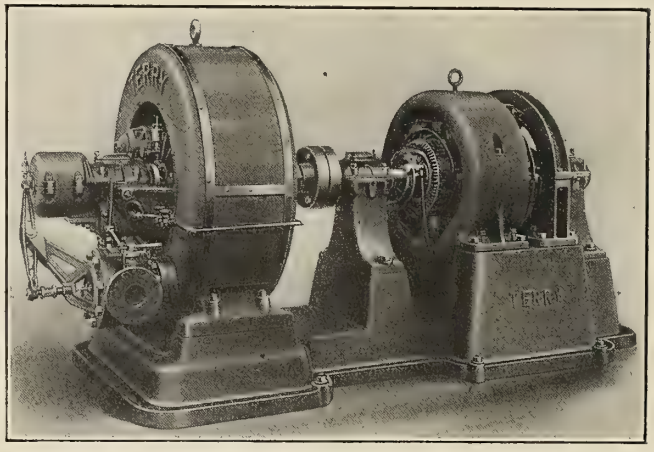


FIG. 3.—100-KILOWATT TERRY TURBO-GENERATING SET FOR S. S. MINNESOTA

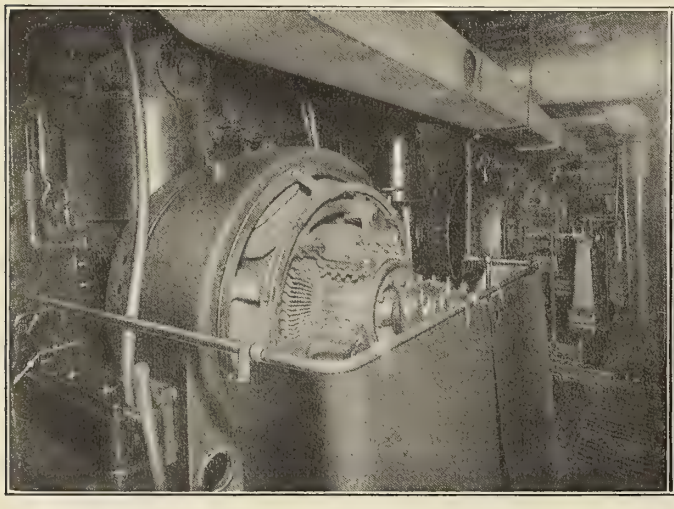


FIG. 1.—DYNAMO ROOM, WITH OLD 75-KILOWATT ENGINE SETS

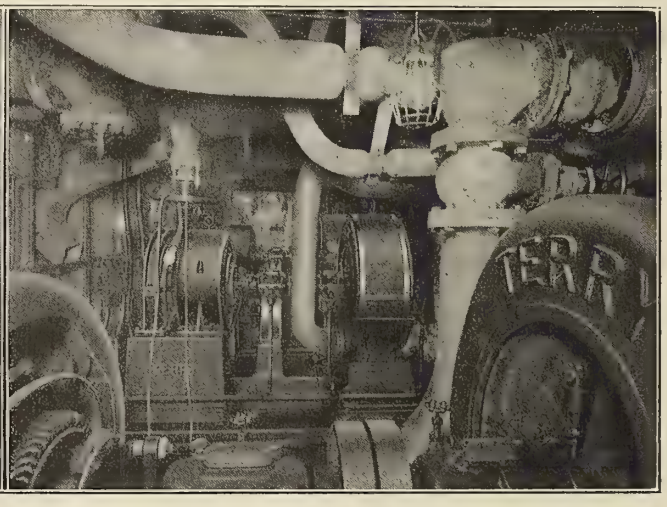


FIG. 2.—DYNAMO ROOM, WITH NEW 100-KILOWATT TURBINE SETS

These Terry turbines are of the single-wheel, multi-velocity type, with one 36-inch wheel. The jets and reversing chambers are of bronze, arranged with large clearances over the wheel. The bearings are all of the ring oil type with water circulation. The glands for non-condensing work are sealed with oil, while for condensing service they are sealed with low-pressure steam. Under neither condition can any oil enter the steam space, thus eliminating one serious source of trouble experienced with the old engine sets.

Steam is supplied to the turbines at full boiler pressure of 230 pounds. The designed exhaust pressure is 10 pounds, and

the exhaust is piped to lead to the closed feed-water heater, to the low-pressure receiver of the main engine, to the main condenser, to the auxiliary condenser, or overboard.

The Crocker-Wheeler generators are of the inter-pole type, with single commutator of the shrink ring construction. The weight of a complete unit, including the base plate, is about 9,000 pounds.

The installation of these sets was made in record time by the ship's crew, under the direction of Mr. Adams, chief engineer, and Mr. C. C. Lacey, marine superintendent, and without any assistance from the manufacturers. Three days after the arrival of the shipment on the docks at Seattle the sets were installd, connected up, and the *Minnesota* left port with all three machines in service. Since that time, over a year ago, they have been in continual and successful service.

Steam Yacht Cyprus

Of special interest to yachtsmen this year is the palatial steam yacht *Cyprus,* launched from the yards of the Seattle Construction & Dry Dock Company, Seattle, Wash., Sept, 24, for Mr. D. C. Jackling of Salt Lake City. The vessel was designed and built under the supervision of Messrs. Cox & Stevens, New York, to whom we are indebted for the following particulars:

The dimensions of this new yacht are:

Length over all	230 feet 6 inches
Length on waterline	215 feet
Beam	28 feet
Draft	12 feet 6 inches
Speed	17 knots

This vessel has many striking features, as the owner imposed upon his architects the task of producing a vessel combining an unusually high maximum speed with the greatest possible accommodation for her dimensions. It was further required that the vessel should have a steaming radius of at least 4,000 nautical miles at cruising speed, and that it should be suitable for extended ocean cruising in heavy weather with comfort and safety to those on board.

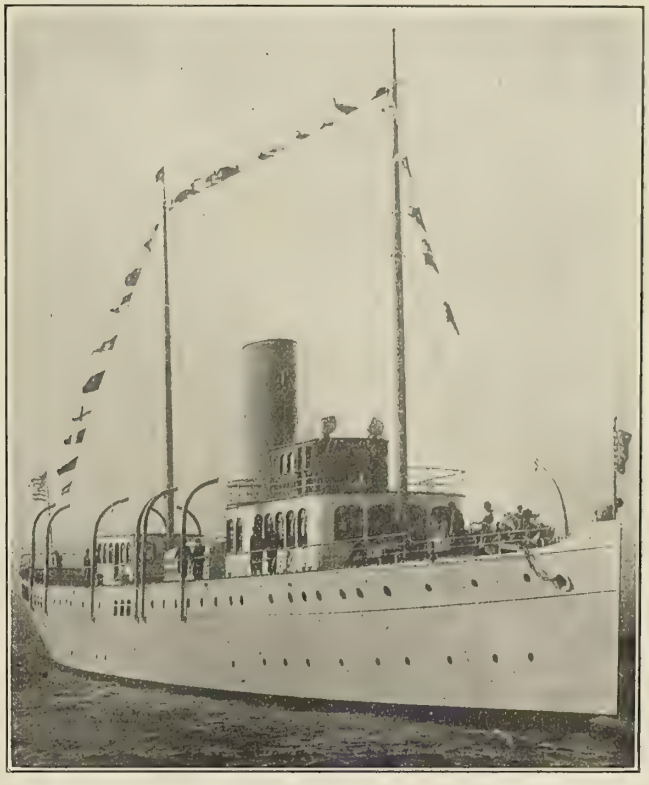
Having these requirements in mind, Messrs. Cox & Stevens decided upon the steamer type of hull as possessing many advantages over the conventional yacht type. The architects further decided that in order to enable this vessel to maintain a high speed at sea, it was better to adopt the double-deck type, and accordingly the plating has been carried right up to the upper or shade deck, a feature which permits of unusual accommodation on the main deck.

An inspection of the lines shows a form that should be admirable both for speed and seaworthiness, as there is a moderately sharp entrance and a very easy run aft, considerable dead rise to all the sections and a pronounced flare above the waterline forward, which will tend to keep the vessel very dry under all conditions.

The hull is built throughout of heavy steel in excess of the underwriters' requirements for vessels of this class, and to ensure the maximum possible safety from collision special attention has been paid to the matter of watertight subdivision. There are nine transverse watertight bulkheads, built of heavy plating; there is a complete double bottom extending the full length of the vessel, and in addition, both forward and aft of the machinery space, a heavy watertight deck has been worked, very largely adding to the safety of the ship. The space beneath these watertight decks is utilized for stowage of fuel, water and other stores.

The form of hull decided upon has made it possible to secure an unusual amount of accommodation for the owner, his guests and for the crew of the vessel, this having been still further increased by the adoption of two four-cylinder triple-expansion engines, steam being supplied by a battery of Babcock & Wilcox boilers, using oil as fuel. The adoption of twin-screw propulsion and oil fuel not only largely reduces the amount of space assigned to the machinery department but also made possible a considerable reduction in the engine-room force.

The fuel oil, of which some 260 tons is carried in carefully constructed tanks formed by structural watertight bulkheads, is stowed partly in a large 'thwartship tank between the boiler room and engine room, and partly forward and aft in hold tanks under the watertight decks. All of these tanks are very thoroughly subdivided by swash bulkheads, and are provided



THE CYPRUS

with all the most approved appliances for ventilation, filling and emptying.

The outfit of auxiliaries is most complete, including an elaborate electric light plant with sufficient capacity to light the entire vessel, including two large searchlights and illuminating belt and to operate a powerful wireless outfit, there being storage batteries of ample capacity to take care of lighting the ship when the dynamo is not running. The vessel is steam-heated throughout, and an elaborate system of interior telephone communication has been provided. Hot and cold running fresh and salt water is supplied, and a large cold storage plant has been installed, making it possible to keep provisions for a long cruise in warm climates.

The hold space aft is given up to fuel tanks, water tanks and certain storerooms, while in the forward hold there has been arranged a most complete system of storerooms so that the vessel can be fitted out for extended cruising.

On the lower deck forward a very considerable portion of the space has been given up to cold storage space, there being separate rooms for meats and vegetables, and in addition on this deck are the owner's storerooms, including wine lockers, space for dry stores and provisions for the crew.

On the lower deck forward of these storerooms are arranged four staterooms, each with two berths, providing accommodation for the cooks, stewards and waiters, these rooms having adjoining them a separate toilet room. Forward of the stewards' and guests' quarters on the lower deck is the lower forecastle, providing berthing and messing accommodations for six oilers and firemen and twelve sailors, the deck force

being separated from the engine-room force, and each having their own toilet room.

The accommodation for the rest of the crew consists of officers' quarters in the upper forecastle, where there are five separate staterooms, comfortably equipped with accommodation for all the officers of the ship with the exception of the captain, who has his own room and toilet in the pilot house, and the chief engineer, who has a room on the main deck abreast the engine-room enclosure, the officers' quarters having a large and comfortable washroom with shower bath and all conveniences.

With the exception of a small portion of the main deck, taken up by the officers' quarters, the entire space on this deck is utilized by the owner and his guests, and is arranged as follows:

At the extreme forward end of this space is a large stateroom extending the full width of the vessel with a bathroom adjoining. These staterooms are all finished in Colonial style, with massive mahogany furniture and doors, the bulkheads, ship's side and overhead being finished in ivory white. The bathrooms are all tiled on the floors and also have a wainscoting of tiling.

A passage leads on the center line aft from this stateroom, and on each side of this passage are two extremely large staterooms, the baths being arranged between each pair of staterooms. Aft of these comes a boiler enclosure, on the port side of which is arranged a galley, officers' mess room and laundry, also a bakery and a drying room. On the starboard side, abreast the boiler room enclosure, is a passage finished in teak, and this passageway communicates with the forward quarters on the main deck, and has a lobby where companion stairs lead up to the upper deck to the dining room.

This passage at its after end leads into the music room, 21 feet by 26 feet, extending the full width of the vessel, finished in Java teak, handsomely paneled, with furniture to correspond, and having overhead a very handsome dome skylight, so arranged as to give a very beautiful lighting effect in this room. In order to make this room especially attractive an unusual feature has been adopted: the openings on the side, instead of air ports, are large plate-glass windows, the lower portion being fixed for safety and the upper arranged to open, thus giving splendid ventilation and light.

Aft of the music room on the center line is the engine-room enclosure, the chief engineer's stateroom being on the port side of this enclosure, also a large trunk room. On the starboard side of the engine-room enclosure the space is arranged as an entrance hall and gun room or armory, the main starboard gangway opening into this space, and a hall running athwartships at the end of the engine-room enclosures communicates with a similar gangway on the port side close by the trunk room.

From this hall a passageway leads aft to the owner's private apartments, and one stairway leads down to the owner's and guests' quarters on the lower deck, and another stairway leads up to the after deck house, which is arranged as a smoking room, and has at its forward end a wireless room with a berth for the wireless operator.

The owner's private apartment consists of a large stateroom on the port side, with bathroom adjoining. On the starboard side, opposite the owner's private quarters, is placed a stateroom for his secretary, with bathroom adjoining and an office for the owner's use. The owner's quarters are finished throughout in selected Thibet oak, the bathrooms being fitted as in the forward end of the vessel.

The passageway between the quarters of the owner and his secretary runs aft and opens into the library, 22 feet by 16 feet, which extends the full width of the vessel. This room is finished throughout in Thibet mahogany, and has over it a small dome skylight. The windows are arranged in the same way as those in the music room.

Aft of the library the side plating of the vessel is cut away for a considerable distance above the bulwarks, leaving an open space across the deck, covered, of course, by the upper deck, having a large and comfortable upholstered seat running around the stern of the vessel and two large upholstered seats running across the vessel at the forward end. This part of the ship will be most attractive, being perfectly protected from the weather and at the same time open to the fresh air.

The companion stairs mentioned above lead from the hall at the after end of the engine-room enclosure to the lower deck aft, landing in a hallway on the center line of the ship. On each side of this hallway are two very large guests' rooms with bathrooms between. These rooms are finished throughout in Colonial mahogany furniture and doors with ivory white elsewhere. On this same deck and aft of the guests' quarters, accommodation is provided for four servants, with their own bathroom and also a large storeroom for the stowage of linen, pressing tables and all conveniences necessary for the use of the owner's servants.

The owner's dining room is placed in a large steel deck house on the upper deck forward of the smokestack, and accessible from the lobby in the passage on the main deck, this room being finished on the inside with very handsome selected India teak. This steel deck house contains, in addition to the dining room, a large pantry at its after end, connecting by dumbwaiter to the galley, which is located below. On the starboard side opposite the pantry there is a deck toilet.

The pilot house, reference to which has already been made, is placed directly on top of the forward deck house, the top of which is arranged as a navigating bridge, to be used in good weather by the captain or by the owner and his guests.

While the arrangement of the interior is remarkably successful, another most attractive feature of this yacht is her immense and practically uninterrupted shade deck, running from stem to stern, completely covered by awnings and affording a most delightful promenade.

The deck and life-saving equipment of the *Cyprus* is unusually ample, as she carries on each quarter a large lifeboat, and in addition three large and portable launches, one of these being a high-speed boat and the other two heavy, substantial launches, one being for the owner's use and the other for the service of the ship.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—At the annual meeting of the American Society of Mechanical Engineers, which will be held at the Engineering Societies building, New York City, Dec. 2 to 5, papers on the following subjects will be presented: Boilers and Their Operation; Cement; Enameling; Fire Protection, with Special Reference to Turbo-Generators; Oils and the Novel Use of Sprinkler Systems; Gas Measurement; Gas Power Engineering; Lineshaft Bearings; Machine Tools; Management; Properties of Steam; Rope Drive; Steel Railway Cars; Textiles, Covering Mill Engineering; Vacuum Cleaning.

SHIPBUILDING RETURNS.—The Bureau of Navigation reports 98 sailing, steam and unrigged vessels of 38,059 gross tons built in the United States and officially numbered during the month of October. Ten of these vessels, aggregating 27,616 gross tons, were steel steamships built on the Atlantic and Gulf coasts. The largest was the *Matsonia*, of 9,728 gross tons, built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., for the Matson Steamship Company, San Francisco, Cal. The next largest was the *Santa Cecilia*, of 6,309 gross tons, built at the Cramp Shipyard, Philadelphia, Pa., for the Atlantic & Pacific Steamship Company.

Ballin Sectional Watertube Marine Boilers

BY J. B. C. LOCKWOOD*

Two boilers of the Ballin sectional watertube type, using oil fuel under natural draft, were installed on the fast passenger steamer *Tacoma,* which was built by the Seattle Construction & Dry Dock Company, Seattle, Wash., and placed in service between Seattle and Tacoma last June. These boilers supply steam at 250 pounds pressure to a four-cylinder triple-expansion engine developing 3,650 indicated horsepower. In spite of the fact that they are placed in an open cabin without any fiddley overhead, they do not radiate sufficient external heat to discomfort passengers who are accommodated immediately alongside the boilers, as shown in Fig. 1.

CONSTRUCTION

The construction of this type of boiler is radically different from any other now in use. It is truly a sectional boiler, inasmuch as it consists of sections, nested together, but independent of each other, each section being a boiler in itself, having its own feed, steam and down-flow pipes.

FIG. 1.—BALLIN BOILERS INSTALLED IN OPEN CABIN, WITH SEATS FOR PASSENGERS ALONGSIDE

All of the generating tubes are straight and stand vertically, attached at the ends to bottom and top headers, the lower ones having D-sections and the upper rectangular sections. These headers are rolled from solid drawn steel tubes, and are grouped together, so that the lower ones form a continuous corrugated crown sheet over the furnaces, the upper ones a solid roof over the generating tubes. There are two groups of such sections, surrounding a combustion chamber extending the full length of boiler and closed on top by the steam drum, to which all of the upper headers are connected by short nipples.

The only bent tube in the boiler is the one connecting each section to the center bottom drum. The curvature of this tube takes up the unavoidable expansion and contraction in the section. Beyond the outer row of tubes each bottom header is connected by a vertical, straight tube to an outside bottom mud-drum.

All tubes used are seamless drawn steel 1½ inches in diameter, of No. 12 B. W. G. above and No. 10 B. W. G. around the furnaces. The tubes in the generating sections are screwed into the bottom headers with fine (14 per inch) threads, which have a taper of 1½ inches per foot. They are expanded into the top headers, and the holes in the top of the header are closed with plugs, allowing for the insertion or removal of each tube. Special expanders are furnished for expanding the screwed end of the tubes should any leak appear around the bottom threads.

From experience it has been found that the best material for these plugs is soft cast iron, as this material will not strip the threads in the headers when the plugs require removal for the purpose of inspection or repairs. The plugs have considerable taper on the threads, and are made hollow so that they are easily broken in case they stick. They are inexpensive to renew.

Each section has two staggered rows of tubes. The feed and down-flow tubes of each section are expanded in bosses, stamped into the bottom headers and screwed or expanded at the bottom. The curved tubes are connected to the bottom center drums by ground steel unions, which are protected from the fire by a row of firebricks.

The bottom headers extend to the outside of the casing, and are provided on the ends with screwed plugs, which project through, and are accessible from the outside of the casing for inspection and cleaning of the headers. Plugs are also provided in the lower headers over each of the bottom tubes. The nipples connecting each section to the steam drums are screwed into welded ends of the top headers and expanded into the drums. It will thus be seen that in order to extract a complete section it is only necessary to cut the top (or steam) nipple and the straight outside down-flow tube and unscrew the coupling near the center drum.

The casings are provided with large shutters on the top and sides, so that every part of boiler is accessible. To facilitate removal of such shutters they are provided with quick-opening dogs and latches.

COMBUSTION CHAMBER

As already mentioned, the fire from both furnaces passes first into the common combustion chamber before entering between the generating tubes. With coal fuel, firing causes

* Consulting Engineer, Portland, Ore.

smoke, which soots the tubes, but in the Ballin boiler, if firing in the two furnaces is done alternately, this smoke is consumed in the combustion chamber by the hot fire entering from the opposite furnace and sooting of tubes is minimized. The hot gases have a chance to expand around the generating tubes, and are prevented from making a short-cut to the outside by baffles secured to the outside of the sections about half-way down the length of tubes, leaving, however, a small

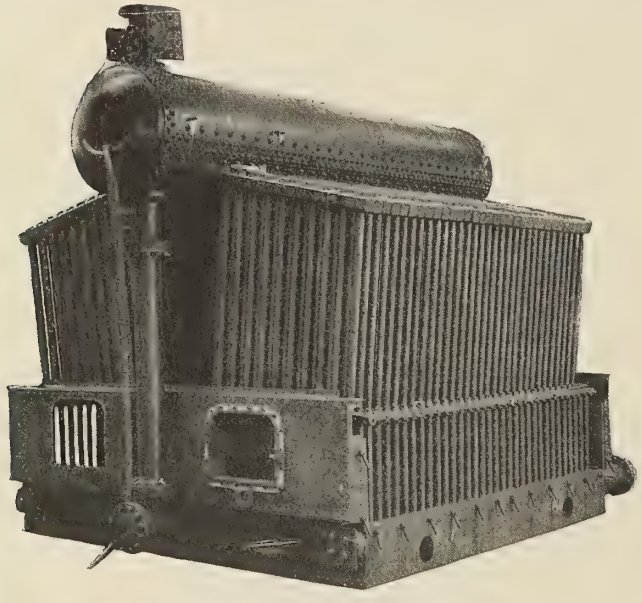


FIG. 2.—BALLIN BOILER, WITH CASING REMOVED

opening on top, under the top headers, to prevent dead corners. Between the outside of the sections and casings flue chambers are provided for the escaping gases, which thence rise up into the top chamber of the casing surrounding the steam drum and finally pass into the stack.

Against the sides of the casing, forming flue chambers, are laid feed-water heaters, consisting of coils of extra heavy pipe, which absorb the heat left in the gases after they have passed all of the generating tubes. Incidentally they keep the side of the casing cool.

CIRCULATION

As already stated each section constitutes a boiler in itself, so that the circulation in one section does not affect that of any other. As the most intense heat is always applied to that part

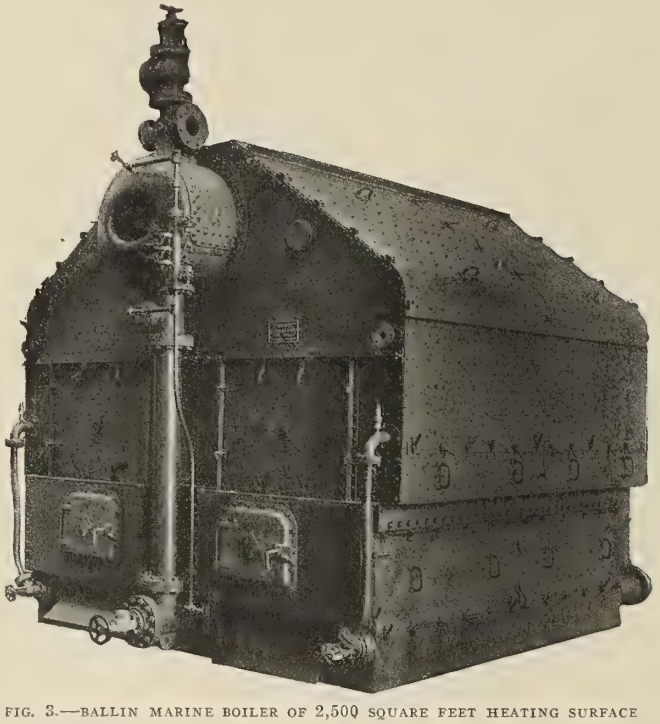


FIG. 3.—BALLIN MARINE BOILER OF 2,500 SQUARE FEET HEATING SURFACE

of the section nearest the combustion chamber, and as the gases always pass first between the curved up-flow, or feed pipes of each section, the water contained in the generating tubes of this part of the sections is the first to rise upwards, and not being able to pass into the steam drum through the comparatively small nipples connecting each section with same, it is forced to deflect away from the drum and pass down through the cooler tubes further away from the combustion chamber. Thus a circulation inside of the section is set up and maintained as long as heat is applied. The bubbles of steam generated throughout the section, seeking the highest point,

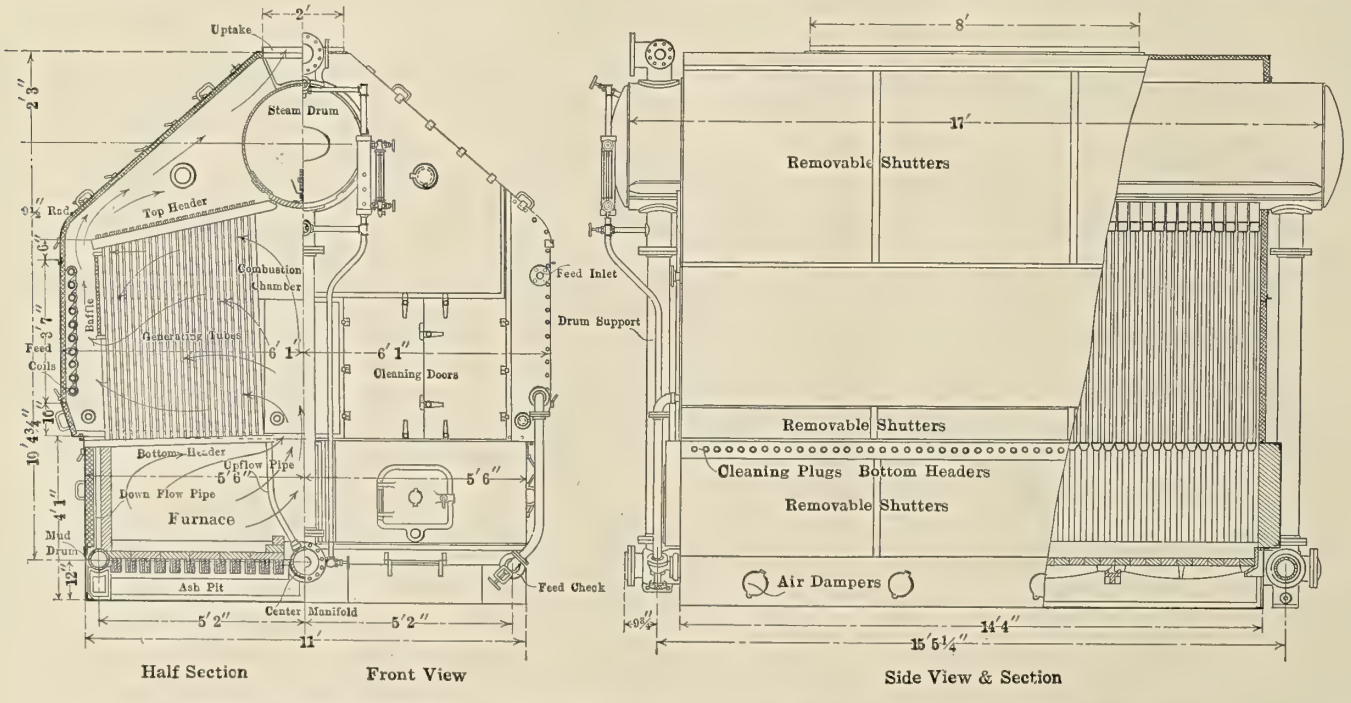


FIG. 4.—BALLIN MARINE WATERTUBE BOILER OF 5,500 SQUARE FEET HEATING SURFACE INSTALLED ON THE STEAMSHIP TACOMA

will naturally rise up and escape to the steam drum, entraining very little water.

While in practically every boiler now in use, separation of steam and water must take place in the steam drum, it will be seen that in the Ballin boiler the separation takes place in each section, a feature which constitutes an important step toward the ideal boiler.

In one of the Ballin boilers a section was removed after five years of constant use, and the lower D-shaped header was cut in two for inspection. No vestige of sediment could be found inside of the header, proving the rapid and perfect internal circulation. Some of the generating tubes of the same section were split lengthwise and showed clean metallic surfaces with the original ridges, left in drawing the tubes, still visible.

As under conditions of rapid generation of steam more water rises in a section than is formed into steam, this excess is taken care of by the down-flow pipes on the outside of the furnaces, through which this surplus is returned to the bottom mud-drums. Here it meets the fresh feed water of lower temperature, which causes all impurities contained in the feed water to precipitate in these drums, from which it is easily blown off.

On many occasions salt water had to be used in boilers now in service, a thing which means destruction to most boilers of this type. The fact that on such occasions salt never appeared in the water column proves that the circulation of the water does not pass through the steam drum, but is confined to each section. For this reason water can be carried very low in the steam drum, and almost the entire volume of the drum is utilized for steam only, for which it is intended.

In order to provide for proper equalization of the water level, and to take care of any water carried into the drums by entrainment, two large down-flow columns outside of the casing connect the bottom of the steam drum direct with the center bottom manifold. These columns also act as structural supports for the drum.

Advantages

From the above description it is seen that the steam generating parts of the boilers are homogeneous, consisting of all solid-drawn steel tubing, sufficiently strong to withstand 1,000 pounds internal pressure and not subject to deterioration from galvanic action or unequal expansion or contraction. While feed-water compounds were at first considered necessary, they have been discarded for the last four years as not needed. The boiler is exceptionally light and compact. The weight per square foot heating surface varies from 15 pounds in small units to 10.5 pounds in large units of 6,000 square feet and more. With oil fuel and natural draft the boilers evaporate from 5.5 pounds of water per square foot of heating surface, while with exhaust in the stack the two boilers installed in the Portland fireboat evaporated 8.8 pounds per square foot of heating surface.

In summing up, the qualities of the Ballin boiler which should be considered by naval architects, owners and engineers, are easy accessibility for quick inspection and cleaning of the inside and outside of all tubes, the possibility of making quick repairs with simple tools by the engineers themselves, light weight, dry steam, immunity to damage by use of salt feed, compactness, and the fact that they can be built in sizes up to 12,000 square feet heating surface, and are specially adapted for sea-going steamers on account of the small amount of water carried in the steam drums and the ability of keeping as steady a water level as in Scotch boilers.

New York Nautical School.—The U. S. S. *Newport*, loaned by the Navy Department to New York as a public marine school, was formally transferred, on Nov. 1, from the jurisdiction of the Board of Education of New York City to the State of New York. By the transfer the opportunity for a nautical education is now extended to young men throughout the State instead of only to young men residing in New York City. This school has been in existence for forty years, and the present school ship has accommodations for about 100 young men who wish to be trained for the mercantile service. The board of governors in charge of the school consists of J. W. Miller, Eugene F. Moran, Henry M. Randall, John H. Finley, Edwin T. Douglass, Charles H. Bessekeimer, George L. Norton, Fred B. Dalzell and John C. Halzel.

Progress of U. S. Naval Vessels

The Bureau of Construction and Repair, Navy Department, reports the following percentage of completion of vessels for the United States navy:

	Tons.	Knots.		Aug. 1.	Nov. 1.
BATTLESHIPS					
New York	28,000	21	Navy Yard, New York	85.8	92.0
Texas	28,000	21	Newport News Shipb'g	91.7	96.0
Nevada	28,000	20½	Fore River Shipb'g Co.	40.3	49.2
Oklahoma	28,000	20½	New York Shipb'g Co.	37.7	48.7
Pennsylvania	....	....	Newport News Shipb'g	2.0	11.8
TORPEDO BOAT DESTROYERS					
Cassin	742	29½	Bath Iron Works	99.3	100.0
Cummings	742	29½	Bath Iron Works	90.4	100.0
Downes	742	29½	New York Shipb'g	63.7	81.7
Duncan	742	29½	Fore River Shipb'g. Co.	98.0	100.0
Aylwin	742	29½	Wm. Cramp & Sons	96.9	97.4
Parker	742	29½	Wm. Cramp & Sons	93.5	95.2
Benham	742	29½	Wm. Cramp & Sons	92.3	93.0
Balch	742	29½	Wm. Cramp & Sons	91.8	92.6
O'Brien	742	29½	Wm. Cramp & Sons	7.1	14.9
Nicholson	742	29½	Wm. Cramp & Sons	7.3	13.6
Winslow	742	29½	Wm. Cramp & Sons	7.0	14.2
McDougal	742	29½	Bath Iron Works	12.6	34.3
Cushing	742	29½	Fore River Shipb'g	12.6	21.3
Ericsson	742	29½	New York Shipb'g Co.	9.6	15.1
SUBMARINE TORPEDO BOATS					
G-4	....	....	Wm. Cramp & Sons	93.4	96.4
G-2	....	....	Newport News Shipb'g Co.	88.1	89.7
H-1	....	....	Union Iron Works	94.5	97.9
H-2	....	....	Union Iron Works	93.0	97.9
H-3	....	....	Seattle Con. & D. D. Co.	91.4	98.0
G-3	....	....	Lake T. B. Co.	69.6	74.2
K-1	....	....	Fore River Shipb'g Co.	85.9	94.0
K-2	....	....	Fore River Shipb'g Co.	85.0	91.8
K-3	....	....	Union Iron Works	81.6	88.6
K-4	....	....	Seattle Con. & D. D. Co.	78.6	88.0
K-5	....	....	Fore River Shipb'g Co.	72.9	79.3
K-6	....	....	Fore River Shipb'g Co.	72.7	78.3
K-7	....	....	Union Iron Works	71.9	78.5
K-8	....	....	Union Iron Works	71.0	76.4
L-1	....	....	Fore River Shipb'g Co.	6.1	13.0
L-2	....	....	Fore River Shipb'g Co.	6.1	13.0
L-3	....	....	Fore River Shipb'g. Co.	6.1	13.0
L-4	....	....	Fore River Shipb'g Co.	5.5	13.0
L-5	....	....	Lake T. B. Co.	00.0	7.4
M-1	....	....	Fore River Shipb'g Co.	00.0	9.7
COLLIERS					
Nereus	20,000	14	Newport News Shipb'g Co.	93.6	100.0
Kanawha	14,000	14	Navy Yard, Mare Island	1.3	9.4
Maumee	14,000	14	Navy Yard, Mare Island	1.3	5.3

Programme of Naval Architects' Meeting

The Society of Naval Architects and Marine Engineers will meet in the Engineering Societies building, New York City, at 10 A. M., Dec. 11 and 12, to discuss the following papers:

December 11

"Relative Resistance of Some Models with Block Coefficient Constant and Other Coefficients Varied," by Naval Constructor D. W. Taylor, U. S. N.

"Experiments on the *Fulton;* Effect of Bilge Keels," by Prof. C. H. Peabody.

"The Safety of Passenger Ships at Sea," by Mr. G. W. Dickie.

"Structure of Vessels as Affected by Demand for Increased Safety," by Mr. William Gatewod.

"Stability of Life Boats," by Prof. H. A. Everett.

"A Substitute for the Admiralty Formula," by Mr. E. A. Stevens.

"Diesel Engine in Marine Propulsion," by Mr. John Reid.

"The Evolution of the Lightship," by Mr. George C. Cook.

December 12

"Construction and Operation of Western River Steamers," by Mr. R. C. Wilson.

"The Influence of National Policies on Ships' Design," by Capt. W. L. Rogers, U. S. N.

"Strains in Hulls of Ships, Showing the Effects of Pitching and Rolling," by Mr. James E. Howard.

"Change of Shape of Recent Colliers," by Naval Constructor S. F. Smith, U. S. N.

"General Organization of a Navy Yard," by Capt. L. S. Van Duzer, U. S. N.

"Notes on the Performance of S. S. Tyler," by Mr. E. H. Riggs.

Spring Meeting of the Institution of Naval Architects.—The next annual meeting of the Institution of Naval Architects will be held in London, April 1, 2 and 3, 1914.

Electrically-Driven Cargo Boat Tynemount

BY C. VAN LANGENDONCK

The *Tynemount* is an up-to-date, electrically-driven cargo vessel, recently built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., of Wallsend-on-Tyne, to the order of the Electric Marine Propulsion Co., Ltd., Montreal, for service on the Canals and Great Lakes of North America. The hull is 250 feet in length by 42 feet 6 inches beam and 19 feet depth, molded. There are two masts, a forecastle deck and navigation bridge forward, and a poop deck aft. There is one steel deck, and three cargo-holds, with seven large hatches. On the deck are steam winches for working the cargo with three 3-ton derricks.

Among other special features may be mentioned a strong oak fender along the sides of the vessel and forward for protection in the locks, a strong oak quarter badging round the stern, wrecking wells, *i. e.*, vertical trunks to give access from the deck to the double bottom when the holds are full of cargo, a bowsprit for steering, etc.

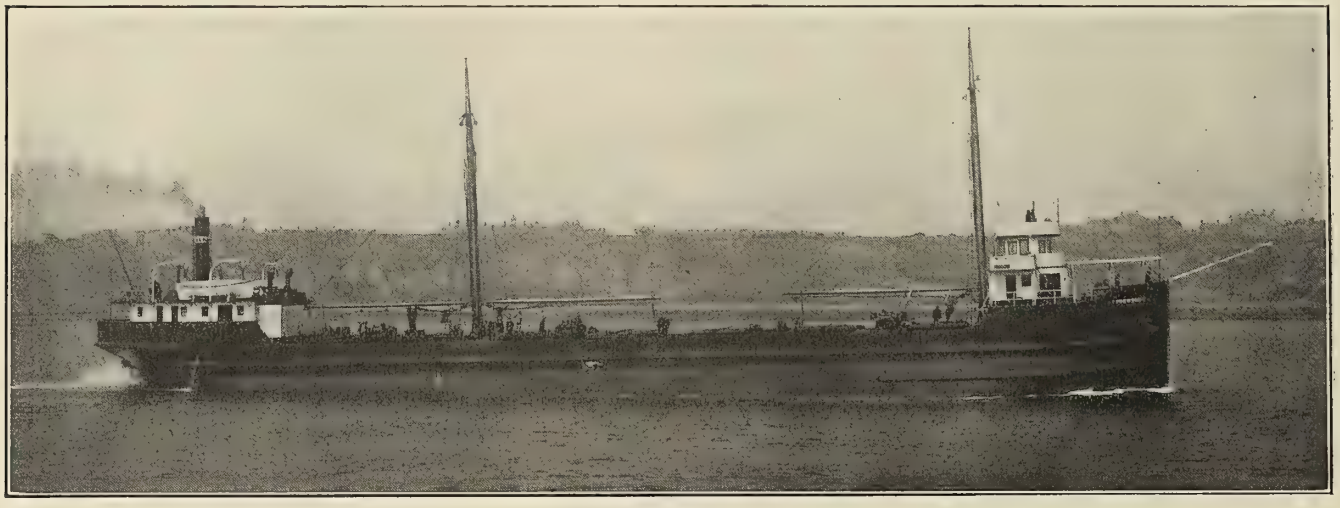


FIG. 1.—NEW LAKE FREIGHTER TYNEMOUNT, PROPELLED BY ELECTRICITY

Deck Machinery

The deck machinery consists of a steam windlass, a steam steering gear, and the three steam winches for working cargo and warping. The auxiliary machinery is supplied with steam from two Cochran donkey boilers placed in the poop and fired by means of oil fuel. The vessel has a double bottom throughout with heavy flush fitted tank top plating; under the cargo holds the double bottom is adapted for carrying water ballast, as is the forepeak, while the tank under the engine room and the after peak may be used for oil fuel. There are also two tanks for oil fuel on the deck forward of the poop bulkhead. In the forecastle is the accommodation for the officers, crew, and oilers, while above are the captain's sleeping room and office, together with wheelhouse, etc. In the poop are the rooms for the engineers, the galley, the dining saloon and the crew's mess room.

Propelling Machinery

The machinery is accommodated right aft under the poop. The prime movers of the installation consist of two 6-cylinder high-speed engines of the Mirrlees-Diesel type. They are each capable of developing 300 brake-horsepower at 400 revolutions per minute on the 4-stroke cycle, the diameter of the cylinders being 12 inches and the stroke 13½ inches. The engines are totally enclosed, forced lubrication being employed throughout. A substantial bedplate is joined with the alternator bedplate at the flywheel end of each engine, the whole being secured to the raised engine seatings, which form part of

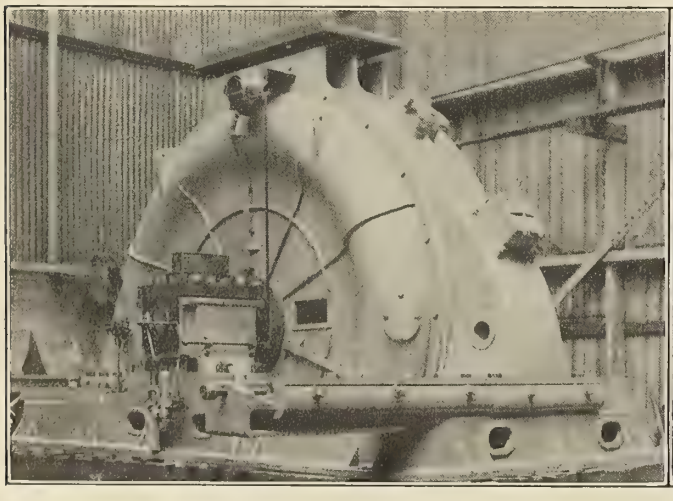


FIG. 2.—MOTOR ASSEMBLED IN THE BUILDERS' SHOP

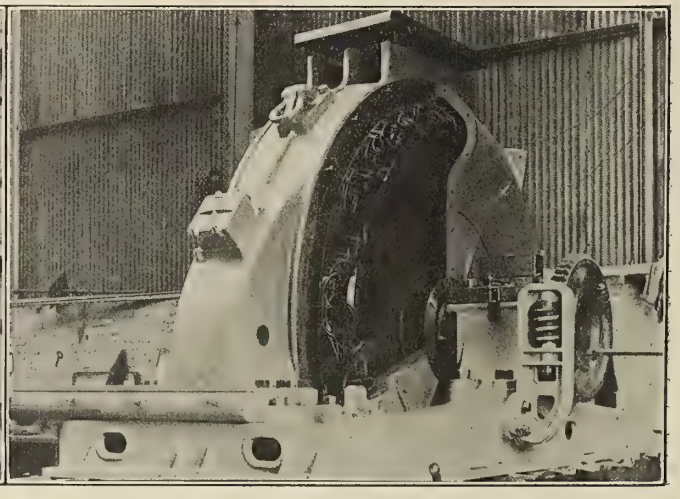


FIG. 3.—MOTOR WITH GUARD REMOVED TO SHOW WINDING

the ship's structure on both port and starboard sides of the engine room. The six cylinders of the engine are divided into two groups of three cylinders each, the vertical shaft which drives the cam shaft being placed between the two groups. The crank shaft is made in two pieces, the gear wheel which transmits the motion to the vertical shaft being bolted between the two flanges of the central coupling, and these flanges are turned solid with the shafts. The engines, which are coupled to the alternators in the usual manner, are placed at the forward end of the machinery space, on the port and starboard sides. A suitable hand-lever barring gear working in an internal rack on the flywheel of each engine provides for turning the engine into the starting position when required.

CONTROL OF THE ENGINES

Starting is effected by means of compressed air, three cylinders only being fitted with starting valves. These are arranged on the three cylinders at the flywheel end of the engines, and their operation is rendered easy for the engineers in charge by a system of bell crank levers and coupling rods transmitting the motion from a control pillar placed on the engine room floor in close proximity to the air receivers of the engines. A device for stopping the engine and means of controlling the amount of air delivered by the air compressor are also provided on the same control pillar. Near at hand is the electric controller of the transmission system, the whole providing a compact and centralized arrangement for the operation of the propelling machinery.

At the after end of each engine, a 3-stage air compressor is fitted, direct driven from an extension of the engine crank shaft. This extension also provides means for driving the lubricating and circulating water pumps.

The two groups of cylinders comprising each engine are carried by two enclosed-type columns, each cast in one piece and provided with inspection doors of ample size. To these columns, on the front or cam shaft sides of the engines, cast iron brackets are fixed, which support grating platforms running along the whole length of each engine on the front side; these platforms provide easy access to the valve gear and valves.

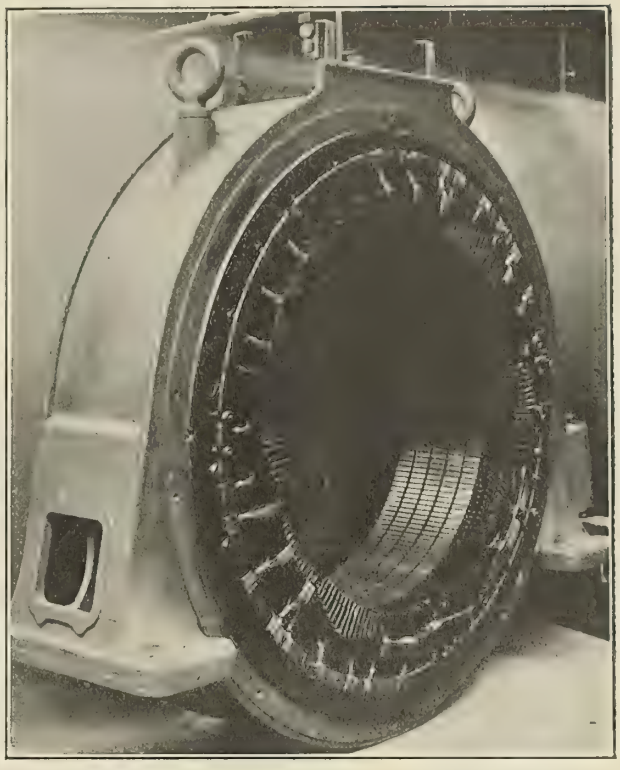


FIG. 5.—STATOR OF ALTERNATOR, WITH GUARDS REMOVED TO SHOW WINDINGS

VALVES AND PUMPS

The valves are situated in the cylinder covers, the fuel valve being of the ordinary needle type, opening vertically upwards; the exhaust and air valves open downwards, and all are operated by cams and levers in the usual manner. An important feature of these levers is the provision of the hinged and bolted joint in each, which allows, by the undoing of one bolt, any lever to be folded back, and by this means the work of withdrawing the valves is reduced to a minimum. All the

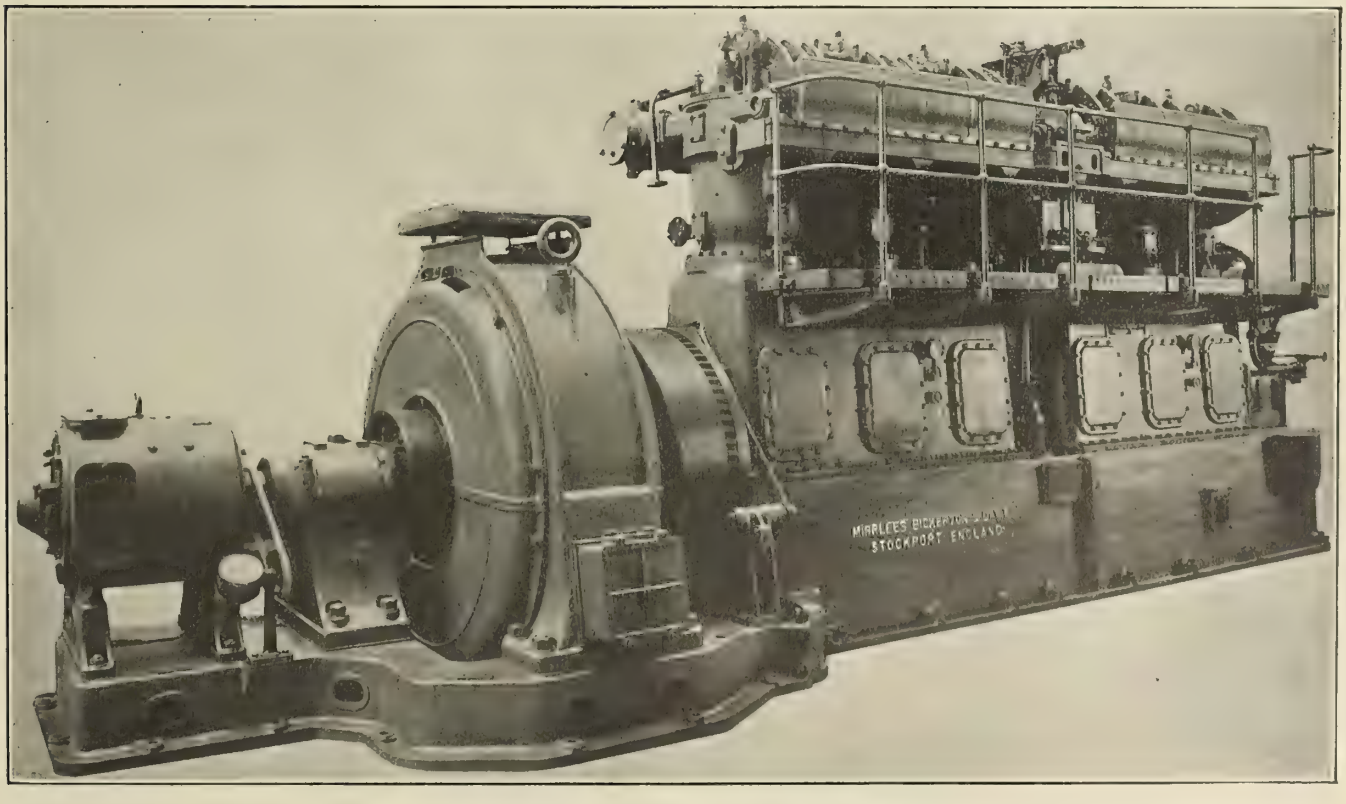


FIG. 4.—ONE OF THE MIRRLEES DIESEL GENERATING SETS FOR THE TYNEMOUNT

valve seats are made separate from the cylinder covers, and can be withdrawn bodily with the valves. Spare valves and seatings are carried, and thus all grinding-in can be done on the bench at the engineer's convenience. The pistons are of the trunk pattern and have separate heads.

The fuel pumps for delivering oil to the cylinders are situated on either side of the vertical shaft gear-casing, and are driven by eccentrics from the camshaft. Each of these eccentrics operates a small crosshead to which are fitted the three plungers of each pump. Fuel oil is fed by gravity to the fuel pump suction chamber from the ready use tanks, which are situated on the forward bulkhead of the engine room. The amount of oil passing through the cylinders is determined by the governor, which is fitted on the upper portion of the vertical shaft, a system of coupling rods and levers is connected from the governor arm to a small spindle passing through the fuel-pump suction chamber and to this spindle tappets are fixed which determine, according to the position of the governor, the length of time the fuel pump suction valves remain off their seats; and until the suction valves are closed no oil will be delivered to the fuel valves on the cylinder covers.

The circulating water, after passing through the engines, goes to the exhaust pipes, which are water-cooled. Thence it passes from each engine, through a water-flow indicator, into a branch piece from which two pipes are led, one pipe going to the discharge valve on the ship's side and the other, by means of a by-pass, to the suction side of the circulating pump. By this means, warm water can be mixed with the incoming water when the ship is sailing in cold waters. When the ship is running in fresh water, it will be possible, by means of a special arrangement, to pass the hot circulating water from one engine into the feed tank of the donkey boilers. When the engines have been stopped and are cooling down, it has been arranged that the sanitary pumps may pass circulating water through them and thus lessen the chances of precipitation of salts or alkaline matter in the jackets.

Generators and Motor

The electrical equipment consists of two Mavor and Coulson three-phase alternators, each direct coupled to one of the Diesel engines. The alternators, when running at their normal speed of 400 revolutions per minute, each give an output of 500 volts and 270 amperes per phase, which absorbs the full power of the engine. They are provided with six and eight poles respectively, making the frequency of the current 20 periods per second and 26.6 periods per second respectively. An exciter is direct-coupled to each alternator and is capable of giving an exciting current of 30 amperes, which can be increased up to 50 amperes while maneuvering.

The current from these two generating sets is led to a 500 brake-horsepower Mavor and Coulson patent induction motor of special construction. The rotor of this motor is of the squirrel-cage type, but the stator is provided with two different and entirely separate windings, one of 30 and the other of 40 poles. When these two windings are supplied with current at 20 and 26.6 periods respectively, they give the same synchronous speed of 80 revolutions per minute. The motor will then absorb the full power of both engines and drive the propeller to which it is direct coupled at a speed of 78 revolutions per minute. This propeller speed corresponds to the fastest speed of the vessel. In order to obtain a slower speed, the connections are altered so that the alternator giving 20 periods supplies the 40 pole winding of the motor; the alternator giving 26.6 periods can be shut down, and the 30-pole winding of the motor is also out of use. The synchronous speed of the motor with the propeller is now reduced to 60 revolutions per minute. One of the engines only is available, but as the speed of the ship is reduced to about three quarters of the normal, half of the total horsepower is ample and the great advantage is obtained of being able to entirely shut down that part of the plant which is not required at the low speed. The motor is readily reversed by interchanging the connections of two of the phases. It will be noted that the two alternators, when both are at work, are connected to entirely separate circuits and they are, therefore, never run in parallel.

Switch Gear

The switch gear, by means of which the necessary changes of connection are made, is extremely simple; it consists of two parts: A main switch of the tramway-controller type, having five different positions: "full ahead," "half ahead," "stop," half astern," "full astern," and of a second switch, the purpose of which is to introduce resistance into the shunt circuit of the exciter.

The contacts of both switches work under oil, but it is inadvisable that the contacts of the main switch should be required to break the large main current flowing to the motor. The two switches are, therefore, interlocked so that it is impossible to work the main switch except when all the resistance has been introduced into the exciter field coils. There is then practically no excitation and the whole system is "dead." With the resistance in the exciter field circuit, the main switch can be moved to any one of its four working positions, and, when the main connections have been made for the new running position, the shunt switch lever is pulled over so as to cut out the resistance and restore the excitation. Until the main switch is definitely on one set of contacts the shunt switch is locked so that the excitation cannot be restored. The whole handling of the ship can be carried out by means of two levers which are so interlocked as to be practically fool-proof. In the present instance, these switches are in the engine room, but it is evident that by lengthening the connecting cables they could be placed on the navigation bridge.

The number of electrical instruments provided has been kept down to a minimum. There are provided only one ammeter and one voltmeter for each alternator and an ammeter and voltmeter for each exciter. The handling of the switch gear is so simple that there is no necessity for multiplication of measuring instruments.

Advantages of Electric Drive

The electrical drive permits the speed of the ship to be altered without altering the engine speed. It also permits a convenient gear ratio to enable the engines and the propeller respectively to be run at their most efficient speeds, and also provides for the ready reversal of the propeller while the engines continue to run in their normal direction. In addition to the above advantages, it is found that in many cases the system allows of a reduction in the machinery space, and also in the bunker space required, thus increasing the cargo capacity of the vessel. As a subsidiary advantage, it lends itself readily to distant control, and in any case where it may be found advisible the switch gear can be put on the bridge and the control of the motor driving the propeller be put into the hands of the navigating officer.

Correction.—A reader calls attention to an error in the instalment of "McAndrew's Floating School" published in our November issue, where it is stated that in all water and steam pipes (standard, heavy and extra heavy) the internal diameter always remains the same. As a matter of fact, the excess metal is always on the inside, the outside diameter remaining the same. For instance, with 1-inch pipe on standard pipe the inside diameter is 1.049, the outside 1.315; on extra strong the diameter is .957 inside and 1.315 outside; on double extra strong the diameter is .599 inside and 1.315 outside. In threading pipe the same dies are used for all weights of pipe, which could not be done if the excess metal were on the outside.

The California, an 11,000-Ton Motor Ship

BY J. RENDELL WILSON

Outside of Russia no firm can claim to have had anything approaching the experience with large ocean-going motor ships that Burmeister & Wain have had. The nearest approach from a point of numbers is that of the Werkspoor firm, although, of course, the A. B. Diesels Motorer & Benz Company have turned out dozens of Diesel-engined craft of under 500 horsepower, but as yet they can hardly be put in the same category as the builders of 2,000-horsepower machinery, although it will not be long before they will be in this position. Burmeister & Wain have now completed in the *California* their sixth large Diesel-engined ocean-going vessel, and the trials were successfully run on Sept. 30 last. This leaves ten more motor ships of very similar size now on order at the same yard, a complete list of which was published in the July issue of INTERNATIONAL MARINE ENGINEERING. The clockwork regularity with which these boats are being turned out is worthy of very favorable comment.

MOTOR SHIP CALIFORNIA

The *California* was built for the United Steamship Company, to the Bureau Veritas, Class 1, Div. ✣, 3/3 L. I. I. P. R. A. and C. P., and her general dimensions are as follow:

Length	405 feet
Breadth	54 feet
Depth	35 feet
Draft	23 feet 3 inches
Displacement	11,040 tons
Deadweight capacity	7,200 tons
Total power	2,700 I. H. P.
Number of screws	2
Speed on trials	11.84 knots

Her propelling machinery consists of two eight-cylinder, single-acting, direct reversible Burmeister & Wain Diesel engines of the enclosed four-stroke type, with cylinders 21.6 inches bore by 29.2 inches stroke. At 140 revolutions per minute each motor develops 1,350 indicated horsepower, and so while slightly larger than those in the *Selandia* they turn at the same speed. Generally speaking, these engines are of the same design, and therefore need no description here, but the modifications that have been made are of interest. Instead of fitting one fuel pump and a distributer to each set of four cylinders, each cylinder now has its own fuel pump, thus affording a more equal supply to each individual cylinder. Cutting out one or more cylinders is now an easier matter, as before, when one cylinder was cut out at the distributer, there was a tendency for the other cylinders to receive too much oil. Another minor, but not unimportant, alteration is that of the reversing, which is now carried out by means of a compressed air motor of similar construction to the Brown's gear as applied to marine steam engines. These alterations, the makers state, have been proved to give good results.

The auxiliary machinery also shows modifications inasmuch as the cargo winches are steam driven, the steam being generated by an oil-fired boiler of 1,000 square feet heating surface and of the Korting type. Consequently the *California* is equipped with a slender funnel, whereas all previous Burmeister & Wain motor craft exhausted through one of the hollow masts about 30 feet above the deck. For auxiliary purposes there are also two three-cylinder, four-stroke Diesel engines of the non-reversible enclosed type, each developing 180 brake-horsepower at 210 revolutions per minute. Each of these motors drives a 50-kilowatt, 100-volt direct-current dynamo and a three-stage air compressor. The latter charges reservoirs with air for starting, reversing and fuel injection, while the dynamos supply current for a number of small motors which operate the cooling water pumps, forced lubrication pumps, bilge pumps and the fuel tank service pump, also current for the Hele-Shaw steering gear, the anchor windlass and electric lighting of the ship.

The fuel consumption, including the main and auxiliary engines, was 173 grammes per brake-horsepower on the trials, which were carried out to the satisfaction of the owners, who were on board. After the ship has been in service for a few months the builders expect that this very economical consumption will even be reduced, as has been the case with the previous five motor ships that this firm built.

DEVICE FOR UNLOADING CARGO.—According to consular reports, the division engineer of the Canadian-Pacific Railway has just completed plans for two swinging bridges, which will be installed at one of the company's piers to facilitate unloading and loading the new steamships *Empress of Asia* and *Empress of Russia*, while taking on coal at Vancouver. These vessels are coaled from side ports, as owing to the arrangement of bulkheads and machinery it is impossible to trim the bunkers from one side. With a coal barge between the vessel and the pier the cargo hatches are about 40 feet distant from the wharf. The bridges are composed of two swinging arms of truss construction, which, when not in use, can be folded against the dock and when extended will support a heavy plank gangway on which trucks can be run, giving a straight run without an incline between the ship's tackle and the freight sheds.

Old-Time War Vessel on the Great Lakes

BY NEIL WILBER* AND LANDIS ISAACS†

In view of the fact that so many historical events are being commemorated in the present year, the ide-wheel iron warship *Wolverine,* formerly the *Michigan,* which was built in 1843 and is still in active service on the Great Lakes, should not be overlooked. One of the most famous events of the war of 1812 took place near the home port of this vessel, and the ships which played a prominent part in that war on the Great Lakes, under the command of Commodore Perry, were built and launched from the same port where this famous "old war horse" is now stationed. In fact, she herself was assembled and launched within a short distance from the place where Perry's fleet of wooden vessels was built, and occasionally she steams majestically down the harbor of her birth as stately and as warlike as any of the latest battleships, varying only in "swell" and "tonnage," but at the same time showing quite a "bone in her teeth" when under way.

In calling attention to this stanch old vessel, however, mention should first be made of Commodore Perry's flagship *Niagara,* which has just been raised from the bottom of Misery Bay, where she was sunk one hundred years ago. The remarkably good condition of the timbers of this vessel can be seen from the photograph, Fig. 1, which shows the *Niagara* as she appeared when raised from Misery Bay in April, 1913. Figs. 2 and 3 show the *Niagara* as she appeared when rebuilt to take part in the Perry Celebration on the Great Lakes. At Put-in-Bay, Ohio, at the upper end of Lake Erie, near where Perry's famous battle was fought, will be erected a shaft 330 feet high, costing $500,000 (£102,500) in honor of the victory and in memory of the soldiers and sailors who where killed in the battle. With the famous achievements of these earlier wooden sailing vessels in mind, it is of interest to trace the career of the later iron steam-driven war vessel and examine her construction.

The *Wolverine* is the oldest iron side-wheel vessel afloat to-day and is in commission when the lakes are open to navigation. Until recently she was a member of the United States Navy and patroled the American boundaries of the lakes from end to end. In fact, this historic old vessel is no stranger to many of Uncle Sam's naval officers and sailors, and it is a matter of interest that the first assignment of the late Rear Admiral George W. Melville, formerly Engineer-in-Chief of the United States Navy, was on the *Wolverine,* in the early fifties.

Recently the *Wolverine* was turned over to the State of Pennsylvania for a naval training ship, to be used on the Great Lakes by the Erie Division, N. F. P. She is used in the winter as an armory where the crew is drilled regularly and taught gun and signal tactics, together with the numerous other duties which fall to the lot of a good sailor in regular service. The result of the training the men receive from the officers of the ships during the winter months is shown by the excellent scores made by the gun crews while on a practice cruise last summer with other naval ships. Gun practice is carried out on the range located at South Manitou Island in

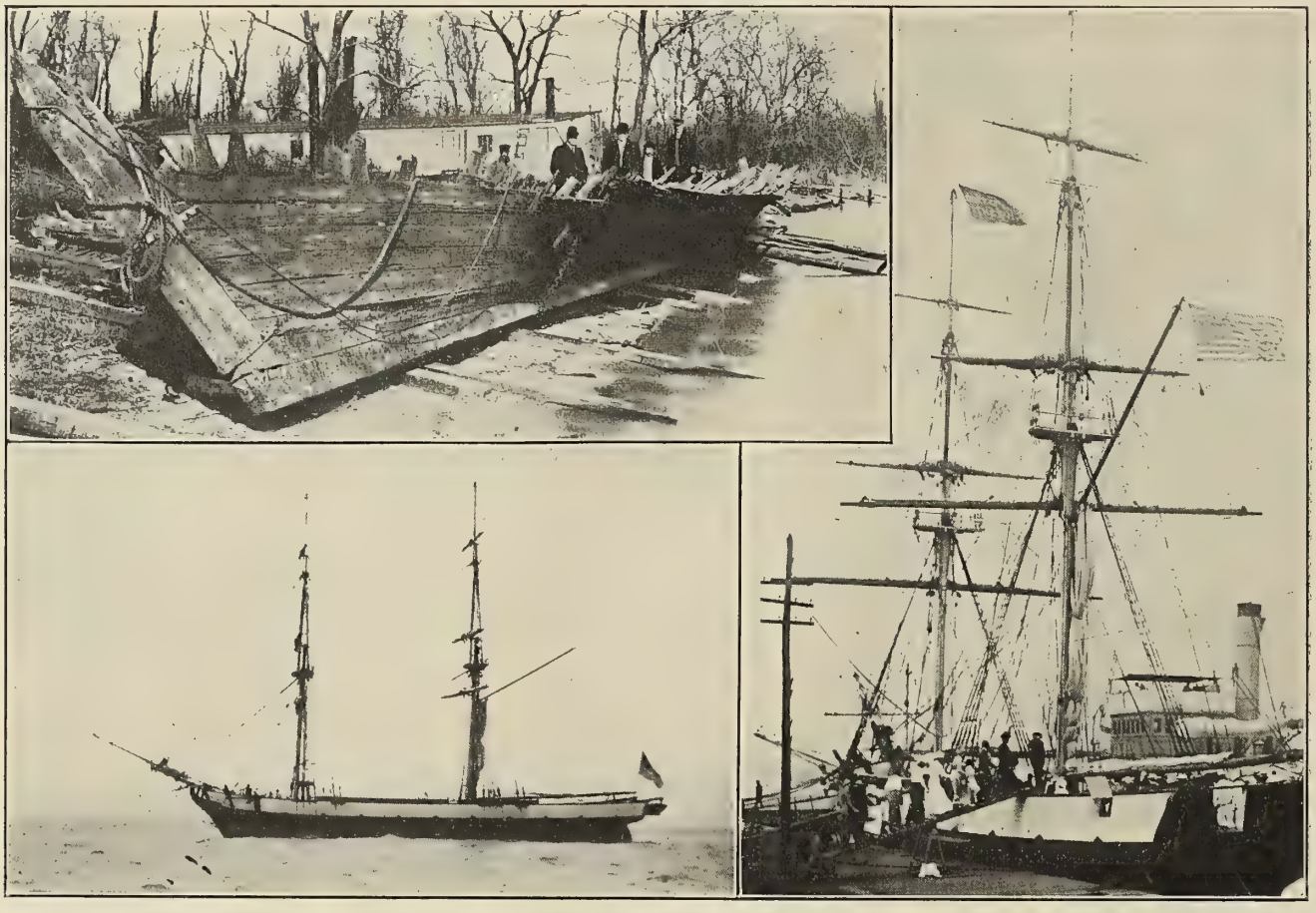


FIG. 1.—HULL OF THE NIAGARA AS IT APPEARED WHEN RAISED FROM MISERY BAY, ERIE, PA., WHERE SHE WAS SUNK ONE HUNDRED YEARS AGO
FIG. 2.—THE RECONSTRUCTED NIAGARA FIG. 3.—VISITORS BOARDING THE NIAGARA

* Ensign N. F. P., acting chief engineer.
† Formerly Ensign N. F. P. and chief engineer.

Lake Michigan. From Erie, Pa., the *Wolverine's* home port, to South Manitou Island and return is a distance of 1,350 miles, and on this cruise last summer the old vessel knocked it out in 147 hours' actual running time, averaging 9½ miles per hour, or a speed of about 8.5 knots, a performance which speaks well for the condition of a seventy-year-old war vessel.

The *Wolverine* was built in Pittsburg, Pa., in 1843, and

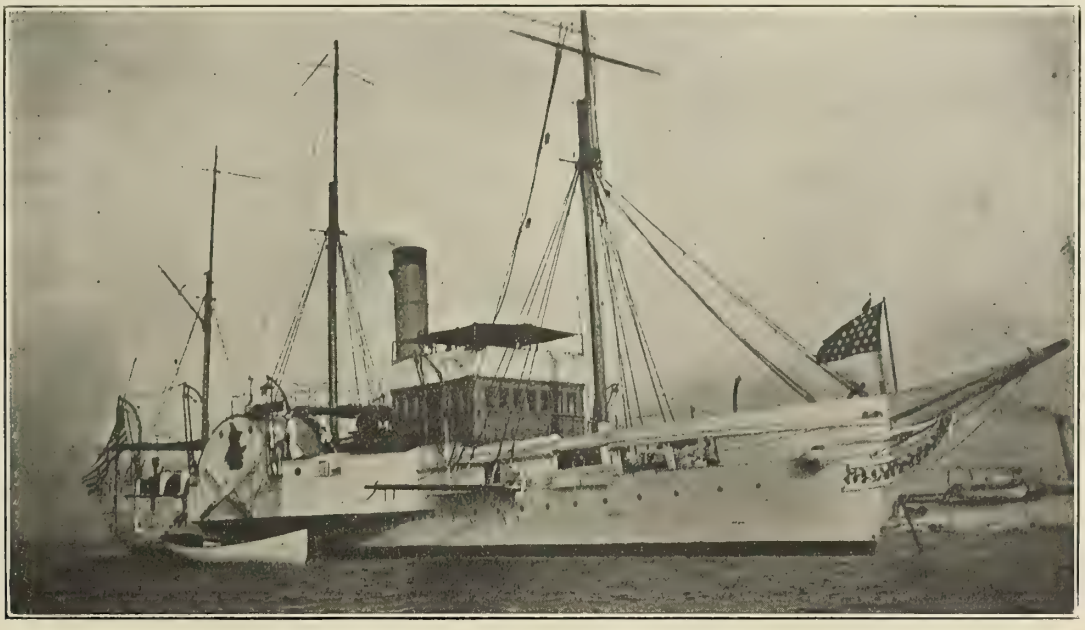


FIG. 4.—THE WOLVERINE, FORMERLY THE MICHIGAN

brought to Erie by mule teams and canal boats. Stackhouse & Tomlinson built the machinery, but whether or not they built the hull is not known. She is a three-masted ship and was originally rigged for sailing as well as steaming, but now depends on steam alone. Her machinery is the most interesting feature on board and shows that our forefathers had the necessary "gray matter" and put it in proper use both in the

FIG. 5.—NAVIGATING BRIDGE AND OFFICERS OF THE WOLVERINE

design of the engines and in the way in which allowances were made for adjustment, etc., to the valve gear and other parts of the machinery. The following description of the hull, machinery, engines, boilers, valve gear and air pumps of this vessel will show many of the peculiarities of her construction and will give marine engineers some idea of the progress which has been steadily maintained in the field of marine engineering.

HULL AND DECKS

The hull is 167 feet long, 27 feet molded beam, 9 feet draft and 685 tons displacement, made of half-inch charcoal iron plates. The frames are 5 inches by 4½ inches and 5-inch by 3½-inch tee bars riveted together, which extend up to the main deck, with 5-inch by 4½-inch tee bars tying her together athwartship. The deck beams are also tee bars. Two steel watertight bulkheads enclose the engine and boiler rooms, which are in the same compartment amidships.

There is a berth deck, main deck, topgallant forecastle and poop deck, with a superstructure amidships. The poop deck contains the captain's quarters, the ship's library and a very interesting register of all the officers in command of the vessel while in commission.

The chart and wheel house is on the superstructure forward of the funnel. The ship is steered by hand from the wheel house, and can be handled below the main deck by a quadrant which is located under the captain's quarters, in the after part of the ward room. The forecastle is used for stowing anchors and deck tackle.

FIG. 6.—STERN VIEW OF THE WOLVERINE

The crew's quarters are forward on the berth deck, which also contains the dispensary and mess gear. The galley is on the main deck forward of the boiler room bulkhead.

The ward room is aft of the engine room on the berth deck, being separated from the engine room by a steel watertight bulkhead. The ward room is large and roomy, as well as cozy, having accommodations for eight officers with lounging room,

pantry and bath. The galley for same is on the main deck aft of the port paddle wheel box.

Directly under the ward room is located the ship's powder magazine and small arm stores, the same having to be brought up by hand through the ward room to the main deck.

The keelsons as shown on the drawings extend through the engine and boiler room, or from bulkhead to bulkhead, and are built of angles and half-inch plate. The gallows frames are built of wood entirely, and are the same as originally installed. There are two coal bunkers outboard of the engines, extending from bulkhead to bulkhead, with a capacity of 50 tons each.

The decks are 3-inch by 3-inch yellow pine calked, with all bolt holes plugged. She has three yellow pine masts with

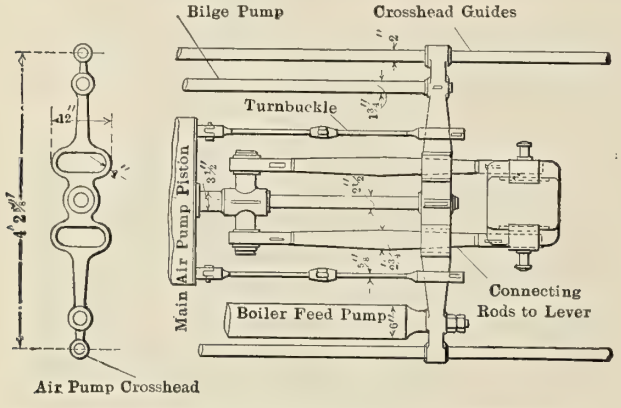


FIG. 7.—PLAN OF MAIN AIR PUMP CROSSHEAD, WITH BOILER FEED AND BILGE PUMPS ATTACHED

crosstrees, gaft and bowsprit and a full complement of boats, including two 5-ton steam cutters, a captain's gig, etc. She is also equipped with wireless and all the latest signaling devices, although for over sixty years the only lights aboard were kerosene (paraffin) lamps.

Guns

The original guns were of the old muzzle-loading type with a breeching made fast to the bulwarks to take up the recoil, but these were relegated to the scrap heap for the more modern Driggs-Schroeder semi-automatic rapid fire six pounders, there being six of them, a Colt automatic field gun, a rapid fire gun and two one-pounders for saluting purposes. Four of the six-pounders have been replaced by two-pounders of later design with telescopic sights, wind gages and night sights. The old Colts .45 revolvers have also given way to the new Colts automatic.

Engines

The machinery consists of two simple inclined engines 36-inch by 96-inch stroke, developing a maximum of 365 horsepower. The engines are coupled together.

The cylinders have dished heads and the crank end head has about half of the steam port cast in it. There is a steam chest forward and aft of both cylinders, which is divided into two compartments, one for steam and the other for exhaust, both connecting with the cylinder ports.

There are two 10-inch brass double-seated steam and exhaust valves, both being worked from one rocker shaft, the lift for the exhaust being increased by the toe on the rocker. In order for the steam to get to the after chest, it must first pass through the upper chest, then through a jacketed copper pipe, through the after chest, and into the cylinder, from whence it is returned through the after chest again and into another copper-jacketed pipe and into the condenser. The exhaust pipe joining the condenser is made of copper and is rectangular in shape.

Both steam chest and cylinder are cast iron, and are splendid castings. The cylinders, steam and exhaust pipes are jacketed with several layers of hair felt, around which is a black walnut corrugated lagging held in place with brass bands. The steam chests are not lagged at all. The crank and head end cylinder heads both bolt on to the cylinder.

Condensers

There is a jet condenser connected to each cylinder. The condensers are cross connected and each one has three connections to the sea, two in the bottom of the ship and one at the side, a little above the turn of the bilge, insuring at all times a good supply of clean water. The connections are through 3-inch copper pipes which have never been replaced since they were first installed. The sea cocks or Dutch cocks

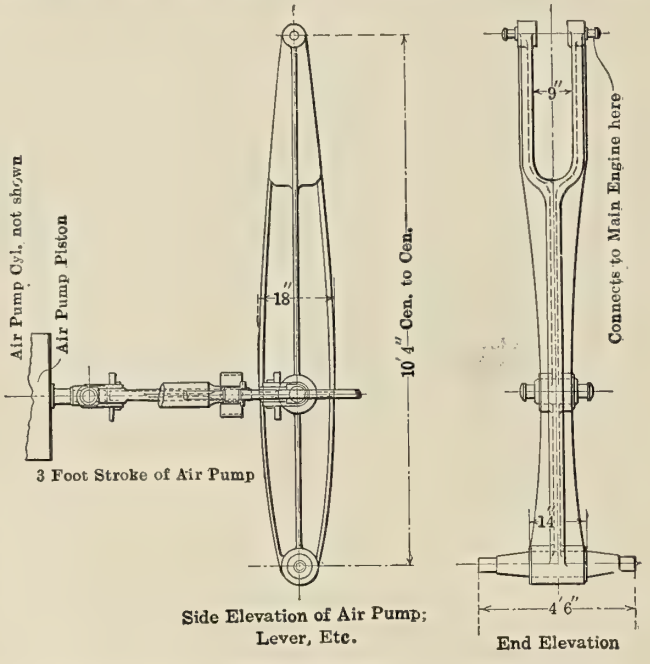


FIG. 8.—AIR, FEED AND BILGE PUMP LEVER, SIDE AND END ELEVATION

are operated through miter gears, by levers, located at the starting platform of the engines.

The condenser base, hotwell and air pump base are in one casting over 10 feet long, extending over the engine keelsons. A manhole is placed between the hotwell and condenser for entering same or inspection of valves, etc.

Owing to their great age, the condensers are very remarkable for the vacuum they maintain, the one on the starboard engine carrying 26 inches and the one on the port 25 inches as maximum, while the minimum for both is 22 inches.

Air Pumps

The air pumps have a 36-inch stroke and are of the combination type, being worked from the main engine crosshead by a cast iron lever 10 feet long, which is supported by the engine keelsons. This lever connects with a crosshead on the air pump which carries the different pump rods.

The main barrel of the air pump is cast iron, 29 inches diameter with a 1½-inch brass liner. On the inboard side of the air pump is a 6-inch brass plunger boiler feed pump, and on the outboard side is a 5-inch cast iron bilge pump. There are feet on the air pump barrel that rest in holders on the condenser base plate, which serve to hold the entire outfit together.

The air pump lever is connected to the main engine crosshead by two connecting rods with gibs, straps, keys, etc. This lever is very peculiar in its design (see Fig. 8), as the main engine connecting rod works through it at the upper end.

The crosshead, rods, gibs and straps are all polished and are in very good condition at the present time. The air pump

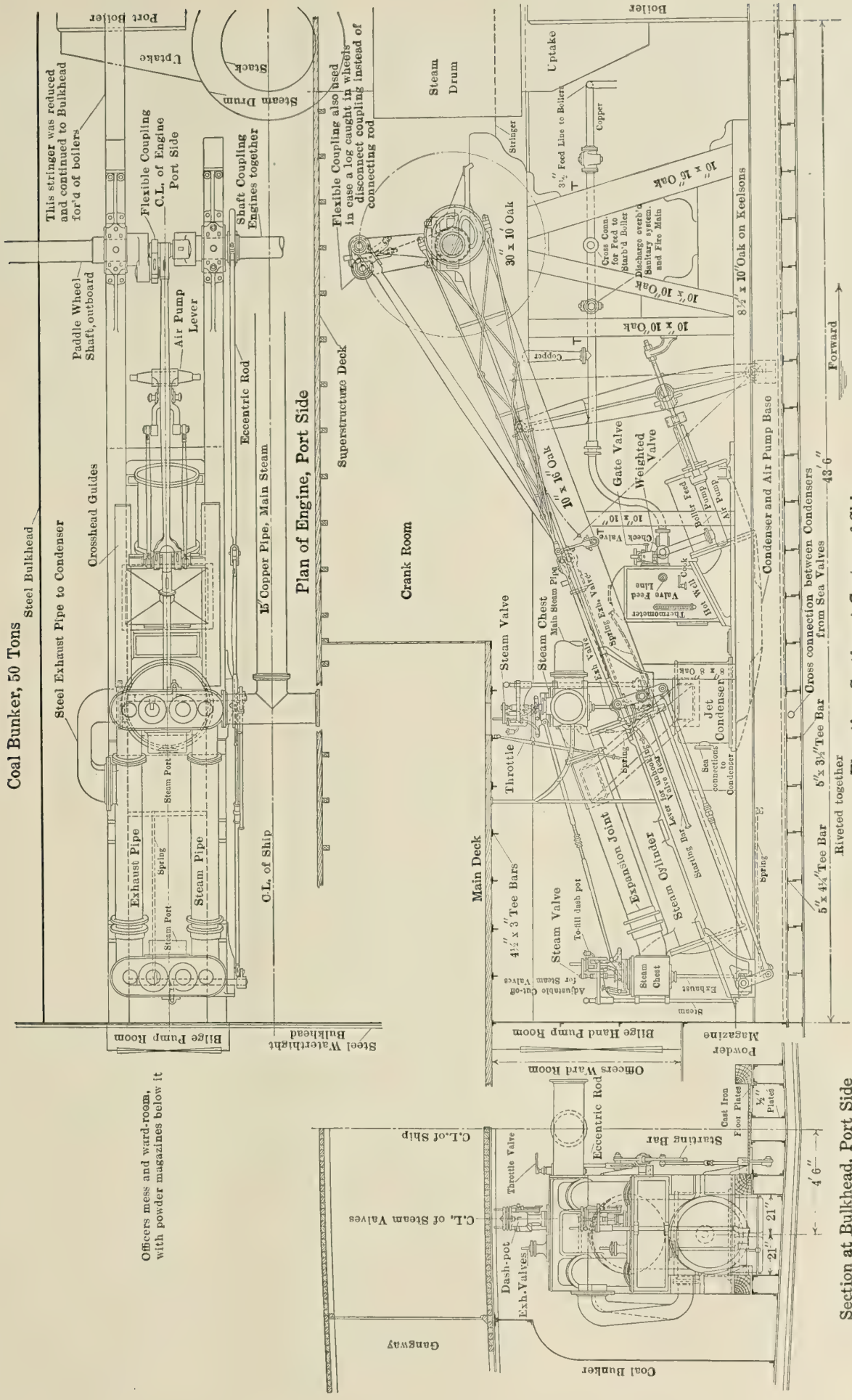


FIG. 9.—LONGITUDINAL SECTION AND PLAN SHOWING ARRANGEMENT OF ENGINE AND MACHINERY, PORT SIDE, AND SECTION AT BULKHEAD OF U. S. S. WOLVERINE

piston is made of solid brass and has two rods with turnbuckles, one on each side of the main piston rod, which allows of lateral movement and holds the piston squarely in place at all times. The air pump piston rod also has a short crosshead attached to it.

Hotwell

The hotwell is at the base of the air pump, as shown in Fig 9. The feed line is so arranged that you can feed the boilers, discharge overboard, to fire mains, and flushing system, or decks, just as the occasion requires. There is also a 3-inch gate valve to which a pipe was connected that was led all around the outside of the ship. This pipe was perforated with small holes and was used to repel the enemy in boarding by squirting hot water and steam on them. It is claimed that this was the real mission of this arrangement, although this pipe has been disconnected.

The feed line has cross connections between the boilers, also two check valves and a weighted valve at the hotwell which seems to act as an outboard delivery valve. The line is 3½-inch copper pipe and is as originally installed. It has an expansion joint and an air chamber, also an expansion bend, as shown in Fig. 9.

The hotwell is supplied with thermometer, cocks, etc., for testing the temperature of the water, and a boiler feed regulating valve, as well as a check valve at boiler.

Valve Gear

The valve gear is of the poppet type with dash-pot and adjustable cut-off. A 1½-inch by ½-inch bar connects the upper and lower together for adjusting the cut-off and is worked from the starting platform.

The steam valves are 10 inches diameter, double-seated brass valves, and are worked from toes on the rocker shafts, which in turn are worked by the eccentrics. The exhaust valves are also 10-inch diameter, double-seated brass valves, the lift of which cannot be changed except by changing the position of the arm on the rocker shaft, thereby giving a greater or lesser area of opening, as desired. The toe for the exhaust valve is very much longer than the one for the steam valve, thus giving it more opening, in order that it may discharge the exhaust steam quickly. There is an offset on the toe of the exhaust valve, so that a spring may be attached to the under side of same. This spring is similar to a carriage spring, and is made of four leaves 2 inches by ¼ inch by 8 feet long. The other end of the spring bolts to the top of hotwell. The spring on the lower gear bolts to a cross bar which is between the engine keelsons.

The object of these springs is to keep the exhaust valves closed, as the pressure in the cylinder is on the under side of them, and the vacuum is on the upper side, therefore they must be strong enough to resist the steam pressure plus the pull of the vacuum minus the weight of the valve, stem, etc. The steam valve is worked from the same rocker shaft as the exhaust valve, but not in the same manner. In this case a vertical stem or shaft with a toe passes in front of the upper steam chest, and in back of the lower chest. On the upper end of this shaft or stem is a spring bar which extends over, around, and up against the "cut-off wedges" or trips. This arm has a spring which holds it in place all the time.

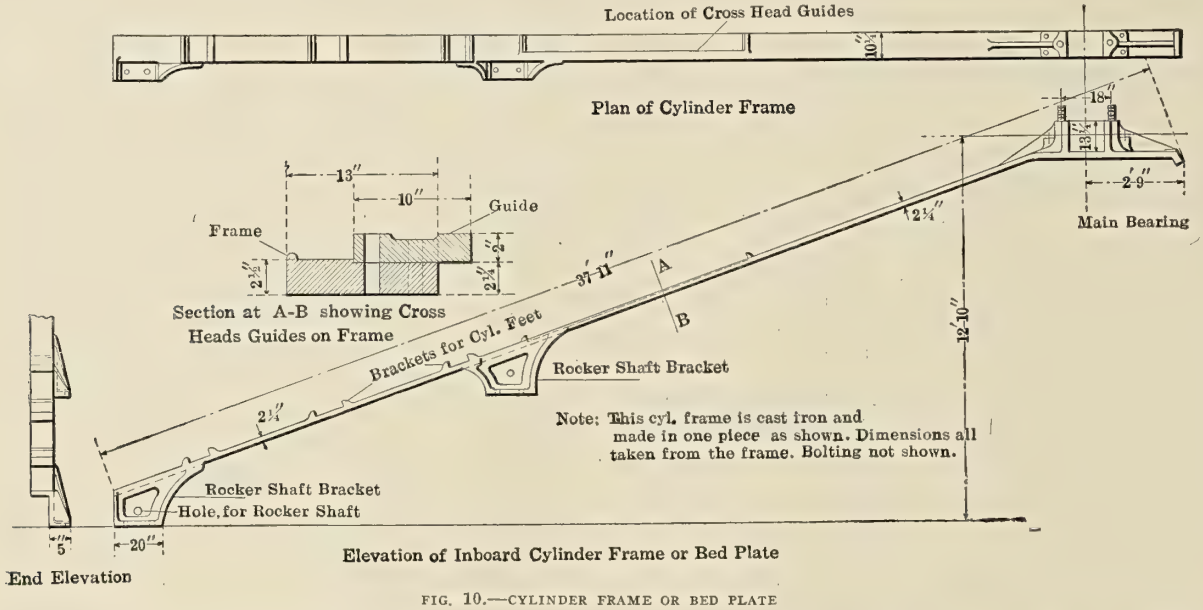


FIG. 10.—CYLINDER FRAME OR BED PLATE

Directly under this spring bar is a brass arm which is attached to the same upright shaft or stem. The dash-pot serves as a guide for this brass arm, as the other end of the arm fits a third of the way around the dash-pot, and as the shaft rises the arm also rises with it and slides against the side of it. Through this brass arm is a 3-inch hole, through which the valve stem proper works. This stem is short, the valve being on one end, and the other end is hooked to the plunger in the dash-pot. In the middle of this valve stem is a round "spool" which is screwed on and held in place by jam nuts. This spool is hardened.

The spring bar is forced in under the spool by the spring when the valve reseats, hence the valve is lifted from its seat when the vertical shaft and arm rises up, due to the action of the rocker shaft, but when the valve is lifted a certain height, or according to the cut-off being used, the arm with the spring is knocked out from under the spool, the valve drops to its seat, being relieved of shock and properly seated by the dash-pot. The arm which lifts the valve also has a hardened piece inserted which fits under the spool, as there is continuous wear on these two pieces. The lift of the valve can be adjusted in two or three different ways, as desired.

The dash-pot is cast iron finished all over, with a cup on the side for filling when necessary. It also has the necessary glands, guides, etc. The cut-off wedges are carried by means of a flat piece bolted to the dash-pot, which takes hold of the cut-off bar at the center; the wedges and radius bars are in one piece, with the wedges at the top to kick out the spring bar. These wedges are two in number, one for cutting off the steam or kicking out the spring bar, the other for keeping the spring bar off the cut-off wedge when it comes down or on the

return stroke. The spring bar has two bevels that coincide with those on the wedges. The radius bar bevels or wedges serve two purposes: First, to keep the wear off the steam wedge and to prevent slam or noise when returning to its position; second, if for any reason the spring bar might stick, steam would be carried the full stroke up and down, and the valve still being open there would be steam on both sides of the piston, but if such were the case, as soon as the spring bar started on the down or return stroke, it would come in contact with the wedge or bevel for reseating the bar, and (finished), and has a latticework eccentric rod which is about 16 feet long and is supported by a pin and connecting rod on the side of the engine frame. The eccentric is keyed on the paddle wheel shaft.

The end of the eccentric rod is solid with a bearing or pin to take the brass box and strap on the connecting rod that hooks on to the rocker shaft. This rod is very peculiar in construction and design, as will be seen by referring to Fig. 9. It flattens out at the part where the hook is, to allow it to slide along over the roller on the pin in the arm on the

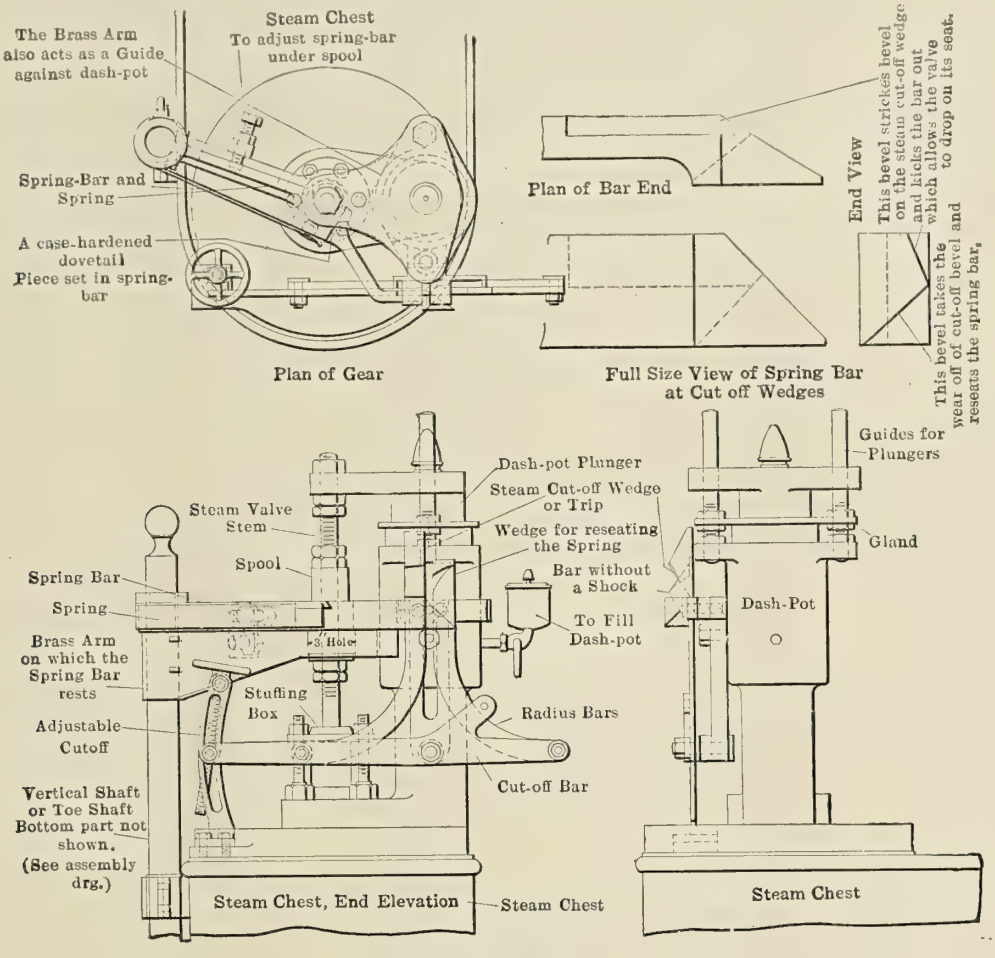

The Brass Arm also acts as a Guide against dash-pot
Steam Chest
To adjust spring-bar under spool
Spring-Bar and Spring
A case-hardened dovetail Piece set in spring-bar
Plan of Gear
Plan of Bar End
End View
This bevel strikes bevel on the steam cut-off wedge and kicks the bar out which allows the valve to drop on its seat.
This bevel takes the wear off of cut-off bevel and reseats the spring bar,
Full Size View of Spring Bar at Cut off Wedges
Guides for Plungers
Dash-pot Plunger
Steam Cut-off Wedge or Trip
Steam Valve Stem
Wedge for reseating the Spring
Gland
Spool
Bar without a Shock
Spring Bar
Spring
Dash-Pot
To Fill Dash-pot
Brass Arm on which the Spring Bar rests
3/8" Hole
Stuffing Box
Radius Bars
Adjustable Cutoff
Cut-off Bar
Vertical Shaft or Toe Shaft Bottom part not shown. (See assembly drg.)
Steam Chest, End Elevation
Steam Chest
Steam Chest

FIG. 11.—STEAM VALVE GEAR

would be "kicked out" from under the spool, allowing the valve to drop to its seat, consequently cutting off the steam at once without any mishap to the engine.

The two valve gears are connected by an adjustable rod, and when the cut-off is changed on one, it is changed an equal amount on the other, and although the gear is very complicated, it gives no trouble and makes very little noise. The plungers will rattle if the dash-pots are not kept full, and they work better after running an hour or so, as the liquid becomes heated and the valves seat quicker and more easily than they do on the start. Considering its age the gear is very remarkable and works wonderfully well.

The valve gear is operated through one eccentric only, the same being the "ahead motion." In case you have to back her, which you most surely do at times, you have to work the valve gear by hand, the same being no light job, as the starting bars are heavy and you must give her steam or lift the rocker arm at the right time or you will block her, and every marine engineer knows the necessity of having his engine under control when in close quarters, or when coming alongside of a dock.

The eccentric sheave is cast iron, the straps being brass

rocker shaft, when it is not "hooked in." To hook the eccentric in, all that is necessary is to pull down on the "Lever for unhooking valve gear," as shown in Fig. 9. The eccentric is unhooked, as shown, and to "Hook her in" you would pull down on the spring and the hook lever would fly out and the hook in the rod would fall into place, on the roller, on the rocker shaft arm, and the engines would run ahead. Of course, it would be necessary to use the starting bar and get the paddle wheels turning, and probably make a few revolutions before doing this.

MAIN CONNECTING ROD

The connecting rod is 16 feet 6 inches center to center, 6 inches diameter at center, 4 inches diameter at ends. It has a brass box, straps, keys and gibs on the crank end. At the crosshead the rod has the usual fork, with straps, keys and gibs for connecting to same. The main piston rod is 4 inches diameter and has a "bald head" on the crosshead end. This "bald head" is keyed to the piston rod with a through key and the crosshead is slipped through a hole in the "bald head," which has a brass journal in it and is held

in place by the boxes in the fork end of the connecting rod.

The crosshead guides are flat cast iron slabs bolted to the engine bed plates or frame, and extend over for the guides to work on. The crosshead also works the air pump through two rods connected to the pump lever.

The main wheel shafting is 11 inches in diameter in the bearing and there are four bearings to each engine, two as shown and two that are outboard, one on the knuckle of the main deck and the other one carrying the extreme end of the shaft in the paddle box.

The paddle box is carried by a steel framework, fastened to the side of the hull and braced up with 2-inch braces, same having a palm which is riveted to the skin of ship, a little above the turn of the bilge strake. The box itself is steel with doors for entering same to oil or for inspection.

(To be concluded.)

McAndrew's Floating School

BY CAPTAIN C. A. McALLISTER*

CHAPTER XVII

Indicator Cards and Horsepower

"My subject this evening will be indicator cards," remarked McAndrew, as his class gathered in the improvised school room after a hard day's work in connection with lowering two of the new boilers of the *Tuscarora* in place.

"Do you know what a steam engine indicator is?" he inquired, looking at O'Rourke, who he surmised would be the first to give a reply. He was not disappointed, as that young man immediately volunteered the information that "an indicator, sir, is a nickel-plated machine that looks something like a pickle castor; you screw it into the outside of a cylinder, tie a string to its tail, let it sneeze three or four times, then unwrap a piece of paper from the outside, which you carry up to the chief engineer, who looks wise, fixes his 'specs,' and delivers the opinion that she's got too much compression, whatever that is."

"That's a fine description, O'Rourke, and shows that you are a man of keen perception, especially as to the 'look wise' part of the performance. The appearance of knowing all about it seems to attach itself to the face of every man who has an indicator card handed to him for inspection. As a matter of fact there are a great many people who look at indicator cards in this manner who don't know much more about them than any of you boys do right now. For that reason I intend to tell you something about them, so that you will not altogether belie your looks when you come to do the 'wise' act.

"An indicator, as its name implies, is used to indicate what transpires inside the cylinder. You all know that steam enters at one end of the engine and leaves at the other; but it is what it does in the meantime which interests us most.

"One of the principal features of the indicator is a small steam cylinder, which can be connected directly to either one end of the main cylinder or the other, at will, by simply turning a three-way cock. The steam acting on the piston in this small cylinder is therefore duplicating exactly its effect on the piston of the cylinder to which it is attached at every portion of its stroke. The up and down motion of this small piston is transmitted by means of a system of small levers and links to a small pencil point, which is made to move in a straight vertical line.

"The other main portion of the indicator is the barrel, which by means of a cord attached to a specially arranged reducing gear, is given a rotary motion corresponding on a small scale, of course, to the simultaneous action of the steam engine piston. Then, by pressing this pencil point, moving always in a vertical line, against a piece of paper wrapped around the rotating drum, a figure is drawn, which, to the initiated, shows exactly what pressure in pounds per square inch is being exerted on the engine piston at every point in its stroke.

"The little piston works against a spiral spring of a tension designed according to the pressure which is expected to be used in the cylinder. On the high-pressure cylinder we would use springs of from 60 to 100 pounds tension, on the intermediate from 20 to 50 pounds, and on the low-pressure a spring of about 10 pounds tension."

Here McAndrew drew the sketch (Fig. 29) on the blackboard, and said, "This represents an ideal indicator card taken from a single-cylinder condensing engine."

"Huh!" remarked O'Rourke, after the sketch had been completed, "that looks like one of those wooden shoes that Schmidt's grandfather wore."

Schmidt retaliated by remarking that he would bet that O'Rourke's grandfather was a bog-trotter, and didn't have shoes of any kind to wear.

"That'll do," suggested McAndrew. "This is no lecture on 'Shoes of All Nations.'

"This card is what you would get off a well-designed engine. The line *PQ* is known as the atmospheric line, or the line

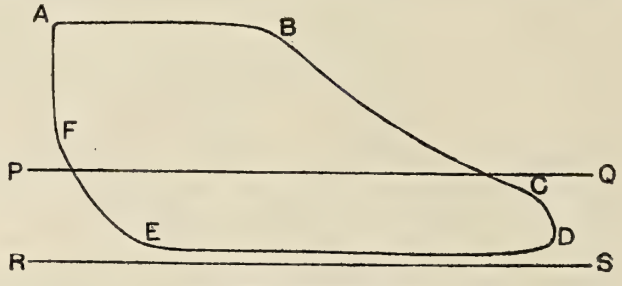


FIG. 29.—INDICATOR CARD

showing the pressure of the atmosphere. It should always be drawn on the card before making the connection to either end of the cylinder, or otherwise your card will not be of much value. The line *RS* is known as the line of zero pressure, and has to be drawn on the card with a ruler. As the pressure of the atmosphere is, as I have told you before, 14.7 pounds per square inch, it should be a distance below the atmospheric line equivalent to that pressure on the scale used for whichever tension of spring has been used in the indicator. For example, if a 30-pound spring has been used, the zero line would be about one-half inch below the atmospheric line and always parallel to it."

"What's *parallel* mean?" whispered O'Rourke to Pierce.

Overhearing the question, McAndrew said, "I am surprised that you don't know the meaning of that term. 'Parallel' means two lines that are the same distance apart at all points, like railroad tracks, for instance; they never meet no matter how far they are extended."

"Schmidt's feet must be parallel, then," interjected O'Rourke. "He' so bow-legged that they have never met yet."

"Now referring to the figure again," McAndrew continued, "you all know that the steam is admitted to the cylinder at the end of each stroke almost instantaneously as the valve opens; this causes the pencil point to go up almost vertically as the revolving drum, following the motion of the engine

* Engineer-in-Chief, U. S. Revenue Cutter Service.

piston, is then practically at a standstill while changing direction. This line *AF* on the card is known as the admission line; as the valve remains open the steam continues to rush in at the same pressure, thus making the line *AB* practically parallel to the atmospheric line. This line *AB* is known as the steam line. *B* is the point of cut-off, where steam can no longer enter the cylinder direct from the boilers. The point of cut-off varies from .3 to .7 of the stroke, according to the various conditions.

"After the valve closes, the steam in the cylinder continues to shove the piston on its travel by the expansive force of the steam. As the piston proceeds on its stroke the pressure of the steam gradually drops, so that the line traced by the pencil assumes a curved shape as shown in the diagram; this line *BD* is known as the expansion line. At the point *D* the valve opens to the exhaust, and the steam rushes out of the cylinder."

"Do they call it 'exhausted' because the steam is tired out from pushing the piston?" inquired O'Rourke.

"Very likely that's the reason," smilingly replied McAndrew.

"The live steam is now being admitted to the other end of the cylinder driving the piston on its return stroke, and the expanded steam, or 'tired' steam, as O'Rourke thinks it is, continues to escape from the opposite end until suddenly the valve closes at the point *E* in the stroke, and a certain amount of this 'tired' steam is imprisoned in the cylinder. As the piston has not yet finished its stroke this portion of the exhaust steam is compresed in the cylinder, and acts as a spring to overcome the momentum of the piston when it reaches the end of the stroke. It thus acts very much like a bumper on a freight car. At the point *F* live steam is again admitted to that end of the cylinder, and the operation, which I have outlined, is repeated.

"The card which I have shown you is, of course, for only one end of the cylinder; the card from the other end will be of the same general shape, and the pair will look like Fig. 30":

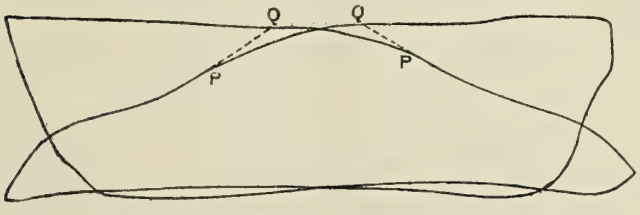


FIG. 30.—PAIR OF INDICATOR CARDS

"That looks like a pair of wooden shoes on a pigeon-toed man."

"What good are all these indicator cards?" inquired Nelson.

"That's the point I am coming to," replied McAndrew. "They are not of any use unless you can read them intelligently. An indicator card to a trained engineer serves about the same purpose as counting the pulse, taking the temperature and looking at the tongue of a sick man does to a physician. You find out what is going on inside. If there is anything wrong with the valves, or if the piston is leaking, it is shown at once on the card. The principal value of a card is, however, to tell how much power is being developed by the engine, and how it is distributed among the cylinders of a multiple-expansion engine.

"Here are some of the examples of wrong valve setting which can be detected.

"All eccentrics of a Stephenson link motion valve gear, the one most universally used in marine work, are set at right angles, or one-fourth of the circumference of the crank circle in advance of the crank, plus a small angle known as the angular advance. Now if this angular advance is too large, cut-off occurs too soon, the steam lead, or time the valve is open before the piston reaches the end of the stroke, is too great, and the opening and closing of the exhaust occur too soon; in other words, all of the functions of the valve are ahead of time, and the result is shown by a card such as I have shown in Fig. 31.

"If, on the contrary, this angular advance is too small, then all of the functions of the valve are too late, and the resulting card will be like Fig. 32.

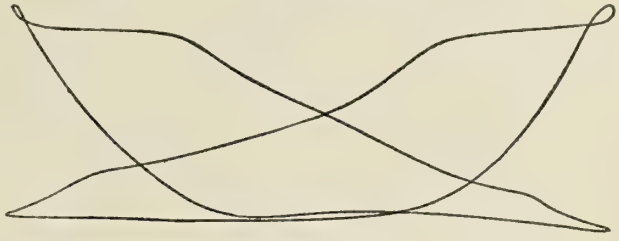


FIG. 31.—INDICATOR CARDS, WITH ANGULAR ADVANCE TOO LARGE

"The steam lap of a valve is, as you have been told before, the amount the valve laps over the steam port when the valve is in its mid-position; the general effect of such a condition is that the cut-off is too soon, the steam opening is late, and as there is not sufficient opening for the entrance of the steam, there is a certain amount of wire-drawing or the effect of passing steam through a contracted opening. This is also indicated by a drop in the pressure, which makes the steam line get away from its parallel position to the atmospheric line. Such a state of affairs produces a card like Fig. 33.

"The opposite effect is caused in all the functions of the valve if the steam lap is too small, as shown by a card like Fig. 34.

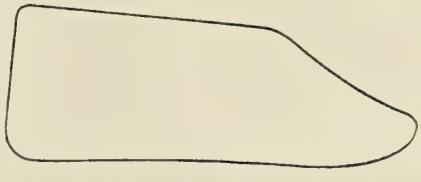


FIG. 32.—INDICATOR CARD, WITH ANGULAR ADVANCE TOO SMALL

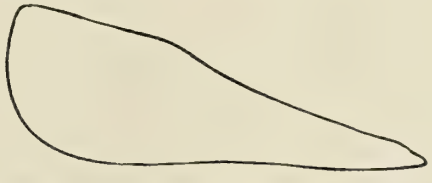


FIG. 33.—INDICATOR CARD, WITH STEAM LAP TOO LARGE

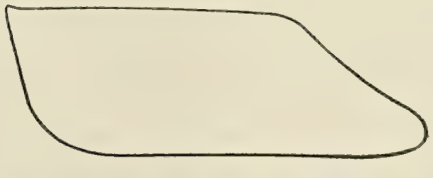


FIG. 34.—INDICATOR CARD, WITH STEAM LAP TOO SMALL

"In the layout of the valve gear the designer may have made the valve stem too long; this would result in too much steam lap on top and too little exhaust lap on the bottom, which would make the cut-off too early at the top and too late at the bottom, the steam opening on top late and at the bottom too early. Such a contingency would produce a card like Fig. 35."

"That looks as if somebody had given it a swift kick," said O'Rourke.

"Exactly so," replied McAndrew. "And if the valve stem

was too short it would look as if it had received a swift kick at the other end.

"Now if the piston was leaking badly the result would be very noticeable on the expansion line, as it would not be so full as it is when the piston is tight and the steam is expanded normally. In other words the expansion line would drop below

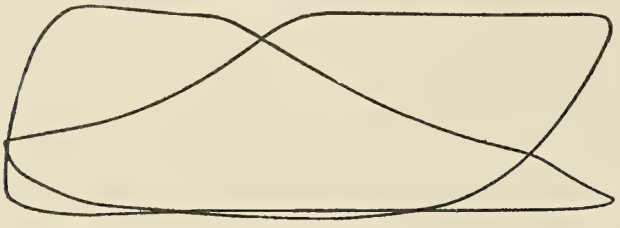


FIG. 35.—INDICATOR CARD, WITH VALVE STEM TOO LONG OR TOO SHORT

its right position on the card, showing that the pressure was low on account of the leak.

"There are many other conditions that are shown by the shape of the indicator cards, most of which can be reasoned out by understanding the general conditions affecting the steam in the cylinder. As your experience in reading indicator cards progresses you will be better able to interpret the conditions which exist.

"We now come to the calculation of horsepower from the indicator diagrams. You will remember that in the early days of this Floating School I tried to impress upon you the meaning of power; that is, that it consists of three elements—force, in pounds; distance, in feet; and time, in minutes.

"The element of distance is quite easily determined, as knowing the stroke of the engine in inches, we can, by counting the revolutions and multiplying that number by two (as it takes two strokes to make a revolution), quite easily determine how far the piston has traveled in any given time.

"The element of time is readily determined by observations on the engine-room clock or on a watch held in the hand.

"The third element, of force exerted in pounds, is more difficult to determine, and is the only essential in the calculation which is furnished by means of the indicator card. We know that the steam enters a cylinder at a little less pressure than shown by the boiler gage, and that it leaves at a greatly

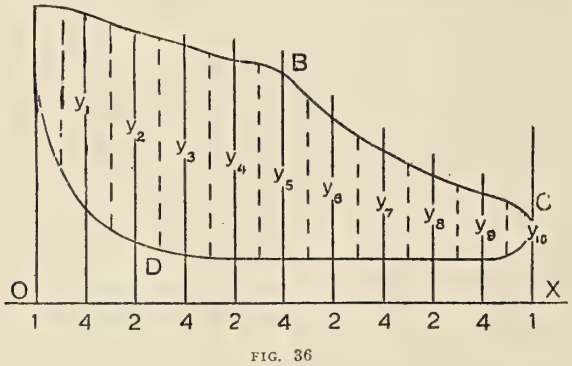


FIG. 36

reduced pressure. When we have different pressures at every point of the piston's travel, in order to determine the total pressure exerted we must take the average of all the pressures. This is where the indicator card comes into use, as from the scale of the spring used it is possible to determine the pressure exerted at every point of the stroke. To get the average pressure from an indicator card the simplest method is as follows:

"Divide the card into ten intervals, as shown by y_0, y_1, etc. Between each of these spaces draw dotted lines just half-way between the full lines. Now add up the lengths of all these ten lines, either by measuring each one separately or transferring them one after another to a strip of paper; divide the total length of all these dotted lines by 10, and the answer, multiplied by the scale of the spring, will give you the average pressure exerted on the piston.

"Another method is by what is known as a planimeter, a small instrument which usually comes with every set of indicators. By this instrument we can ascertain the area of any irregular figure. We can easily measure the length of the card, so by dividing the area in square inches by the length in inches, the quotient will give us the average height, also in inches. This height, multiplied by the scale of the spring, gives the mean or average pressure.

"Having ascertained the mean pressure per square inch, the next step is to find out the total pressure on the piston. The rule for the area of any circle is to square the diameter; that is, multiply it by itself, and then multiply that quotient by the figures .7854, which gives the area in square inches. Knowing the pressure per square inch and the total number of square inches in the piston, we multiply them together to find the total pressure in pounds on the whole piston, which is, as I told you, the last of the three elements necessary in calculating horsepower."

"What has 'drawing' got to do with figuring horsepower?" inquired O'Rourke.

"I don't quite understand you," said McAndrew.

"A guy out here in the shipyard told me only this morning that all you had to do was to remember the word 'drawing' and you could figure horsepower," argued O'Rourke.

"Oh! I see what you are driving at. You mean the word P-L-A-N, not drawing. That word has been connected with the subject ever since horsepower was invented. It is a good way to remember the calculation, providing you know what the letters signify.

P means the average pressure per square inch; *L* stands for the length of stroke; *A* is the area of the piston; *N* is the number of revolutions.

"It is much better to remember the method, however, by reasoning the matter out in terms of force, distance and time, as I have already told you. We want to get the whole problem into so many foot pounds per minute, then we know that dividing by 33,000 will give us the horsepower. The best way to illustrate the method is to work out a specimen for you. For example:

"A certain steam cylinder is 41 inches in diameter, the stroke is 36 inches, the mean effective pressure is 42 pounds per square inch, and the number of revolutions is 110 per minute. What is the horsepower?

"We find the area of the piston as follows:

```
   41
   41
  ----
   41
  164
  ----
 1681
 .7854
 ----
 6724
 8405
13448
11767
------
1320.2574
```

"Now multiply the area by the mean effective pressure

```
1320.25
     42
---------
 264050
 528100
---------
55450.50
```

"This gives us the total pounds pressure exerted on the piston and is the element of *force.*

"The distance the piston moves through is, of course, equal to twice the stroke, as the piston has to go up and down to make one revolution, therefore as 36 inches is equal to 3 feet, multiply by 2, and we have 6 feet as the distance moved in one revolution, and in 110 revolutions it will have moved 660 feet—this is the element of *distance.*

"The element of time is, of course, one minute, as that is the basis on which horsepower is taken.

"Now multiply the force (55450.5 pounds) by the distance (660 feet), and we get 36,597,330 foot pounds per minute. Dividing this number by 33,000 we find the answer to be 1109 horsepower. The calculations I have shown you would be all right if there were no piston rod; but as that is, of course, a necessity, we must make allowances for the area of the rod, as no pressure is exerted on that portion of the piston occupied by the rod. I should also tell you that in making the calculations the mean effective pressure per square inch must be taken as the average obtained from the top and bottom indicator cards.

"To allow for the piston rod it is customary to calculate its area the same as for any other circle, and to take only half the area of the rod from the total area of the piston, as the rod is, as you know, on only one side. Thus the area of a piston rod 6 inches in diameter is 28.274 square inches. One-half of that is 14.137 square inches. This should be subtracted from the total area of the piston 1320.25, which would leave 1306.11 square inches to be multiplied by 42 to obtain the element force, average or total pressure on the piston."

"Chief, what's the use of all this 'dope' about indicator cards and horsepower to the men that drive the engine?" asked Pierce.

"I don't suppose that it is very valuable to the ordinary every-day engine-driving man on board ship, but engineers are somewhat like lawyers in this respect. Every lawyer likes to study about the Constitution and be admitted to practice before the Supreme Court. About one in every hundred ever has occasion to use his knowledge in that connection, but he would be a poor lawyer if he didn't aim that high."

(To be continued.)

November Storm on the Great Lakes

The gale which swept the Great Lakes on Sunday, Nov. 9, continuing well over Monday, Nov. 10, although decreasing in violence toward the close of the day, was marked with a greater loss of life and property than any single storm on record. At least 250 lives were lost, while the property loss runs into millions. No less than nine large steel steamers foundered outright in the open lake, while in addition to these a number of ships sustained serious damage through grounding or by being blown ashore.

On Lake Superior the *Henry B. Smith,* 525 feet by 55 feet by 31 feet, and the *Leafield,* 249 feet by 35 feet 3 inches by 16 feet 6 inches, foundered outright in the open lake, and on Lake Huron the *Charles S. Price,* 504 feet by 54 feet by 30 feet; the *James Carruthers,* 529 feet by 58 feet by 31 feet; the *John A. McGean,* 440 feet by 52 feet by 28 feet; the *Wexford,* 250 feet by 40 feet by 16 feet 7 inches; the *Hydrus,* 416 feet by 50 feet by 28 feet; the *Argus,* 416 feet by 50 feet by 28 feet, and the *Isaac M. Scott,* 504 feet by 54 feet by 30 feet, met with a like fate. The list of the most seriously damaged vessels included the *Motoa, Acadian, H. A. Hawgood, L. C. Waldo, D. O. Mills, William Nottingham, Hartwell, J. T. Hutchinson, Turret Chief, Henry M. Hanna, Regina* and *Northern Queen.*

Inadequate Warning by the Weather Bureau

Considerable criticism has been leveled at the United States Weather Bureau for alleged failure to warn vessels properly of an impending violent storm. The weather report on Saturday, Nov. 8, which was predicted for a period ending at 7 P. M. Sunday, was as follows:

For the Upper Lakes: "High west and northwest winds, diminishing to-night on West Superior. Snow flurries and colder to-night. Sunday, generally fair."

Some mariners claim that this warning is entirely inadequate, and that similar warnings are received for practically every blow which crosses the Lakes. Coming upon the admission of the weather bureau that this storm was a so-called "break," as it doubled back upon itself after having passed the Lake region, it would seem that special effort should have been used to warn Lake vessels passing or leaving port. The local office at Detroit claims to have given ample warning to all vessels passing after Friday morning, Nov. 7, by a special report delivered to them at the Marine Postoffice. The regular reports followed with a weather map attached. Cleveland men claim that all the report they received was "Snow and colder, with winds." It should be remembered, however, that any storm approaching a hurricane in the strict sense of the word is unusual upon the Lakes, and presumably for that reason no hurricane signal is ever displayed at night. Consequently it would seem that in most cases it was up to the individual vessel master to judge the probable severity of the storm, a condition which perhaps should be remedied.

Another point that should be borne in mind is that the peculiar atmospheric conditions existing in the Lake region are a very uncertain proposition, and the task of the weather bureau to give accurate and timely warnings in this district is no small one.

Seaworthiness of Lake Vessels

Turning, however, to the results of the storm and the unusually large number of modern steel ships that were lost, the opportunity for criticism upon and inquiry into the seaworthiness of Lake vessels is admittedly great. It must be remembered, however, that Lake vessels are built for a highly specialized trade, and are therefore subject to some governing conditions which render them apparently much weaker than they should be if compared with the usual types of construction found in sea-going ships. Furthermore, the maximum wave lengths on the Lakes are much shorter than on the ocean, and this permits differences in construction, so that in summing up the principal causes for so many founderings in this storm, one feels constrained to lay it to the shifting of cargo, as that puts the ship in a very bad trim to withstand the sea effectually.

It is a well recognized fact that the bulk cargoes carried in Lake vessels, particularly iron ore, are peculiarly liable to shifting; and although the exact reasons and conditions surrounding the foundering of these ships will never be known, nevertheless, previous experience would seem to show that shifting cargo is responsible for many Lake losses.

The argument will probably be advanced that proper trimming of cargo would obviate this danger. This is perhaps true, but again come in the special conditions existing on the Lakes. While trimming a cargo is by no means an impossibility, still the loading conditions sometimes make it very difficult, to say nothing of causing great loss of time at the docks. When it is considered that the average Lake run with a single cargo is of only 70 to 80 hours' duration, the element of time must be reckoned with.

Comment is often made that the engine and boiler power of Lake vessels is too small for the size of the ship, particularly when severe weather conditions are met with. While there is a very good reason for installing such small power it must be admitted that in a particularly violent blow it is no uncommon thing for a vessel to blow around; that is, to fall off before the wind into the trough of the sea. This is particularly true if the vessel is in water ballast, with a sea heavy enough to cause it to pound, resulting in a loss of headway and per-

mitting the wind to get in its work. It can be easily understood that once in the trough of the sea it is sometimes almost impossible to bring a ship back head up. With several hundred feet of deck exposed to the sea, cut up by 9 or 12-foot hatches spaced every 12 or 24 feet, the chances of total loss are great. In addition to this fact the Lake vessel seldom has sufficient sea room, and a lee shore often looms up all too soon, so that a large number of ships are literally blown ashore.

The general design of Lake vessels is for a special trade, the demands of which are met beyond any possibility of competition, although perhaps the ship, as a type, has some drawbacks in heavy weather. The fact must not be lost sight of, however, that among the ships lost four were of foreign build, and of these only one was built for the Lake trade in every sense of the word. These vessels were the *Leafield, Wexford, Turret Chief* and *Regina,* the last named being the only ship built for the Lake trade.

Wreck of the Charles S. Price

One very peculiar wreck might be mentioned here, and that is the wreck of the *Charles S. Price.* This ship apparently turned back after having gone up Lake Huron some 60 odd miles from the head of the St. Clair River at Port Huron, and she now lies about 13 miles from this place. When the ship was first sighted on Nov. 10, she was lying apparently upside down, with about 100 feet of her hull forward showing above the water, and her stern resting on the bottom in about 60 feet of water. At this time the 20-foot mark on the bow showed plainly, and she gradually settled below the water, until at 9 A. M. on Monday, Nov. 17, over one week from the date of her capsizing, the hull disappeared from sight. It is presumed that air trapped and contained in her hold supported the ship until the gradual release of this air through leakage allowed the ship to sink. This wreck, even upon the Lakes, is a very unusual one, but so far no other theory has been advanced as to the cause of such a condition. Even that must be admitted as a very strange occurrence for a steel ship over 500 feet long.

Summary

Summing up the situation, however, it must be admitted that the Lake ship, with comparatively small power and with a long deck, practically all given over to cargo hatches, has a very bad chance if caught under the conditions enumerated above, particularly if shifting of cargo takes place to windward, and the ship lays in the trough of the sea for any length of time, exposing her hatches to the power of the sea.

Motor Towboat Breakwater

A powerful motor towboat, christened the *Breakwater,* was built recently by the Greenport Basin and Construction Company, Greenport, N. Y., for the Breakwater Company, Hilo, Hawaiian Islands. The boat was built in knock-down form, and together with all equipment and fittings except the planking, decking and joiner sheathing, was crated and shipped by lighter to New York, where it was loaded on an American Hawaiian steamer and transported (by rail across Mexico) to Hilo. The entire shipment consisted of several hundred packages and crates.

At Hilo the erection of the vessel was supervised by Mr. Theodore W. Brigham, president of the Greenport Basin and Construction Company. Laboring under severe handicaps of weather conditions, Japanese labor and delays in receipt of certain shipments, the hull was launched March 3, 1913. The machinery was installed and passed inspection on April 7.

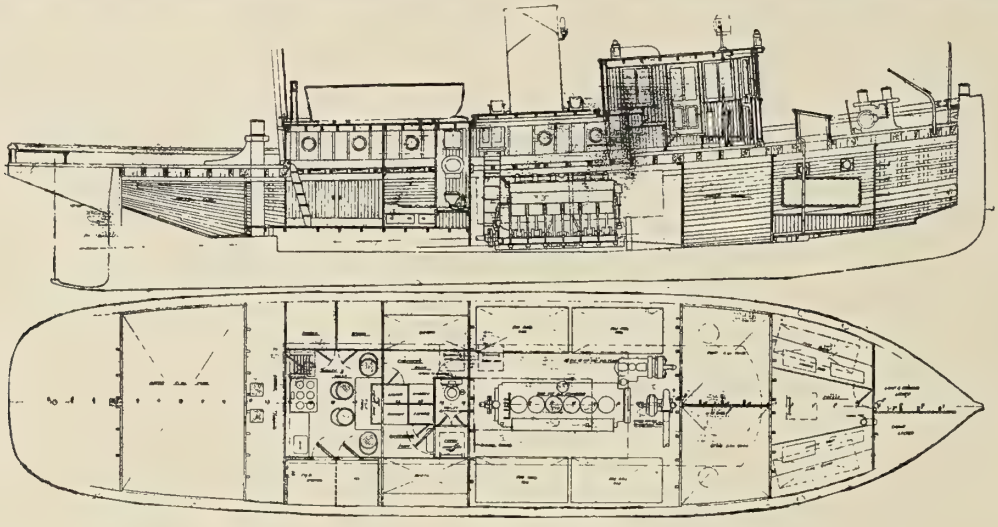


FIG. 1.—GENERAL ARRANGEMENT OF MOTOR TOWBOAT BREAKWATER

The *Breakwater* is 75 feet long overall, 18 feet beam over guards, 8 feet 6 inches depth at side amidships, with a designed displacement of 65 tons on a draft of 5 feet forward and 6 feet 6 inches aft. When finally completed and placed in commission with 700 gallons of distillate and 2,000 gallons of water divided equally fore and aft, she drew 5 feet 4 inches forward and 7 feet aft.

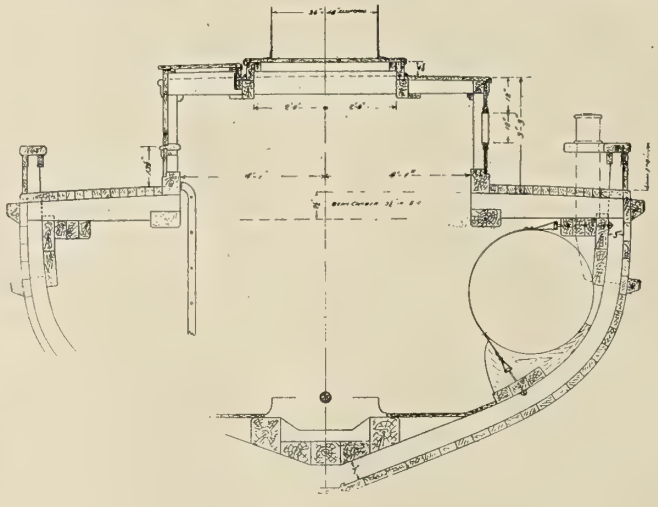


FIG. 2.—MIDSHIP SECTION

The hull is ruggedly framed, with oak keel, deadwood, stem, shaftlog and stern framing, yellow pine keelsons, bilge keelsons, clamps and shelving. The planking is 2½ inches thick and the decking 3 inches thick, with oak plank sheer, top timbers, rails and monkey rails. The framing is double sawn of oak, 4-inch sided and molded 7 inches at the heels and 5 inches at the head. The deck beams are yellow pine 4 inches by 10 inches, with strong beams 10 inches by 10 inches.

Water tanks of 2,000 gallons capacity forward and 1,500 gallons aft are built in holds of 3-inch California red cedar laid Japanese fashion, without calking—a construction that proved absolutely tight.

Accommodation is provided for the captain in the pilot house, the engineer in the port stateroom, and the cook and two deckhands in the fo'csle, where four pipe berths are fitted.

The deck outfit consists of a Hyde tugboat hand windlass for ¾-inch stud link chain, a 2-inch anchor davit, watertight deck scuttles to watertanks, and brass filling plates to fuel tanks, together with the necessary tow boat equipment and deck fire hose connections. The hull up to 8 inches above the designed waterline, including the rudder blade, is sheathed with 18-ounce copper.

The propelling machinery consists of a 300-horsepower, six-cylinder, single-acting, reversing, Standard engine, fitted with the makers' shafting and bearings and connected to a three-blade bronze Hyde propeller, 60 inches diameter by 54-inch pitch. The engine revolutions range from 250 to 275 revolutions per minute, according to the fuel used. Reversing is accomplished by compressed air from storage tanks supplied by a 5 horsepower Standard auxiliary set, which is an integral unit comprising air pump, fire and bilge pump and dynamo.

The exhaust is up through the ventilating stack, which has baffle plates to deflect the rain. There are four fuel tanks of 500 gallons capacity each, 3 feet 6 inches diameter by 7 feet long, built of No. 10 gage open hearth steel, which have manhole plates for cleaning and inspection. The fire, bilge and ballast system is piped with a control manifold in the engine room to give suction and discharge at will from the sea, fresh water tanks, fo'csle bilge, machinery space bilge, overboard and fire hose connections on deck.

Electric lighting is on a 110-volt system, the current being supplied direct from a 1½ kilowatt dynamo on the auxiliary set through a switchboard in the engine room to the searchlight, running and riding lights, and lamps throughout the ship.

The operation of the vessel proves most practical by carrying one tank of gasolene (petrol) and three of distillate, changing from the former to the latter when settling down for a steady run. The operation of reversing, checking, etc., is absolutely certain under gasolene (petrol) but not positive under distillate. The above proportion of fuel represents the average amounts so far used. When running without a tow the speed and freedom from wave-making risistance, indicated especially by the absence of the deep depression usually shown alongside of a tug when speeded up, bears out the care in the design of the underbody, and the upper works show a long parallel side for ease of handling side tows, which also makes for full deck ends and an exceptionally fine sea boat. Considerable attention has been attracted by the installation of internal combustion engines in tug boats of this size and power, as with a steam installation it would be impossible to approach her arrangement of quarters, radius of action, water tank capacity, speed in light condition, and it would be difficult to equal her on tow rope pull.

French Liner Lutetia

The largest and speediest Franch merchant vessel to operate between France and South American ports is the *Lutetia*, which has been built by the Chantiers de l'Atlantique, St. Nazaire. This vessel is the second French liner to be propelled by screws actuated by combination machinery, consisting of triple expansion engines and Parsons reaction turbines. The keel of the vessel was laid June 18, 1912; she was launched March 22, 1913, and left the builder's yards for her trials on Oct. 16. Her maiden voyage from Bordeaux to South American ports will begin Nov. 29.

NEW FRENCH LINER LUTETIA, OF 14,500 GROSS TONS AND 20.5 KNOTS SPEED, FOR SERVICE TO SOUTH AMERICA

The dimensions of the vessel are as follows: Length overall, 599 feet 5 inches; breadth, 64 feet 2 inches; depth to main deck, 44 feet 1 inch; draft, 23 feet; displacement, 15,500 tons; gross tonnage, 14,500 tons; indicated horsepower, 20,000; designed speed, 20½ knots.

The entire hull, including the upper works, is built of Siemens-Martin steel. The double bottom, having a capacity of 1,650 tons of water, has been worked from end to end and is divided into ten watertight compartments. The hull itself is divided by transverse bulkheads into 12 watertight compartments, while the boiler room is further subdivided by three longitudinal bulkheads. The watertight bulkheads are pierced by 23 watertight doors which are operated by hydraulic power, controlled from the navigating bridge. In case any compartment becomes flooded, water may be discharged overboard by pumps having a total capacity of 500 tons per hour.

There are seven steel decks in the ship, three of which have been worked from end to end. Numbered from the top, they are designated as A, B, C, D (main deck), E, F and G. Above the A, or boat, deck is a large deck house containing the officers' quarters, while above this is the navigating bridge and chart house. The navigating bridge is about 55 feet above the load waterline.

The forward part of B deck is arranged as an observation room, with the front and sides, for a length of about 90 feet, fitted with thick panels of glass, which provide excellent

shelter and enable the passengers to have a good view of the sea in any kind of weather. This is used as a promenade deck for the first class passengers only. In the large deck house on the B deck is the first class social hall, library, bookseller's shop, stationery office, entrance to the first class accommodations and elevators, while aft is the smoking room and an open café.

The C deck is also reserved for the first class passengers, containing de luxe staterooms, a dining room, special restaurants, a children's playroom and other special features. In all, there are 154 first class staterooms, which are distributed on the C, D and E decks. Astern, in a large deckhouse, is the second class social hall and smoking room, while on the next deck below is the second class dining room, with the main entrance to the second class accommodations.

Both ends of the main, or D, deck are devoted to the third class and steerage passengers, while amidships are located some of the first class staterooms and the second class dining room. On the E deck, or first 'tween deck, are additional first class accommodations, as well as forty staterooms for the second class passengers. Both the F and G decks are devoted to the third class passengers, their dining room being on the F deck. The steerage passengers are also berthed on these two decks. Amidships, in way of the machinery spaces, are accommodations for the engineers and firemen.

Eighteen cylindrical three-furnace boilers, located in three separate boiler rooms, and working under Howden's system of forced draft, supply steam at a pressure of 200 pounds per square inch. Each boiler room has a separate funnel 115 feet in height above the grate bars and 10 feet in diameter. The total grate surface is 1,205 square feet, and the heating surface 46,930 square feet, making a ratio of grate area to heating surface of 1 to 42.

The ship is propelled by four propellers, the inner propellers being driven by triple expansion four-cylinder engines with cylinders 41, 57, 65 and 65 inches in diameter, respectively, with a stroke of 44 inches. When running ahead, each of these engines exhausts into an independent Parsons reaction turbine, which drives a wing propeller. The engines have been designed for a total of 20,000 brake horsepower. All of the propellers are four-bladed, the inner screws having a diameter of 16 feet 5 inches and a pitch of 23 feet, while the wing propellers are 6 feet 7 inches diameter and 6 feet 7 inches pitch. Under full load the service speed will be 20.5 knots.

The main engines are located in a single compartment with the auxiliaries in a separate compartment.

Towboat Charles P. Greenough

The Portland Company, of Portland, Me., completed and delivered to the Commercial Towboat Company, of Boston, Mass., on Oct. 31, the wooden towboat *Charles P. Greenough* illustrated on this page. The principal dimensions of the boat are as follows:

Length over all	144 feet 8 inches
Molded beam	26 feet 2 inches
Depth of hold	16 feet
Maximum draft with coal, water, etc.	14 feet 5 inches
Displacement	665 tons
Gross tonnage	296 tons
Net tonnage	145 tons
Capacity of coal bunkers	160 tons
Capacity of fresh water tanks	7,500 gallons

Steam is furnished at a pressure of 175 pounds per square inch by a single-end Scotch boiler, fitted with three 44-inch Morison horse-collar type furnaces. The mean diameter of the boiler is 14 feet 4 inches, and the length over all 12 feet 7⅞ inches. The total heating surface is 2,722 square feet and the grate area 82.35 square feet.

TOWBOAT CHARLES P. GREENOUGH, BUILT BY THE PORTLAND COMPANY, PORTLAND, ME., FOR THE COMMERCIAL TOWBOAT COMPANY, BOSTON, MASS.

The engine is of the triple-expansion type with attached air pump driven from the low-pressure crosshead. The cylinders are 15, 24, 40 inches diameter, with a common stroke of 30 inches. The high and intermediate valves are of the piston type, while the low-pressure cylinder is fitted with a flat slide valve. At 120 revolutions per minute and with 175 pounds steam pressure the engine develops 900 horsepower.

The propeller is a four-bladed cast iron sectional wheel, 9 feet 8 inches diameter and 13 feet 6 inches pitch, designed to give the boat a speed of 12.6 knots.

The auxiliaries include an independent surface condenser. The feed water is heated in a filter box by 1½-inch and ½-inch Schutte & Koerting jet apparatus, the 1½-inch connection taking exhaust steam and the ½-inch connection live steam from the boiler.

The electric equipment consists of a 7-kilowatt General Electric 56-ampere, 125-volt turbine generator, with a Portland Company switchboard and also a Portland Company tell-tale board located in pilot house. The pilot house is further equipped with an engine-room telegraph, operated from both the starboard and port sides, and a Rushmore 18-inch type "D" pilot-house projector. The steam steering engine, which is of the Hyde make, is located aft. The ship is also equipped with a Hyde windlass and a Hyde steam hawser engine.

Letters from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

Broken Bottom End Bolt

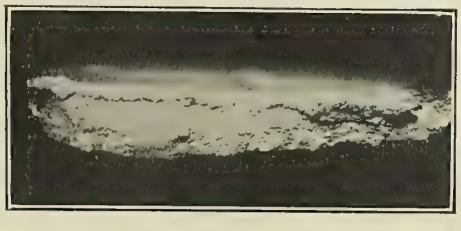
A paddle steamer was taking a pier, and on increasing the speed from slow to full speed ahead a noise was heard, which on examination proved to be due to the fracture of the bottom bolt of the crankpin brass on the high-pressure connecting rod. The bolt broke off at a point on the threaded portion just below the nut, and was obviously due to bad material, only about a quarter of an inch of the bolt remaining sound. To all appearances the flaw was a very old one.

As no spare bolts were on board, and the steamer being only about half an hour's journey from her destination, it was decided to sail her down under the single bolt. The chief engineer did not, however, deem it advisable to put the engine astern, but kept her going ahead dead slow. When giving the engine steam he was also careful to see that the high-pressure engine was on the out-stroke, so that the load would come as much as possible on the connecting rod and not upon the single remaining bolt.

The steamer eventually arrived at her destination safely and the bottom end of the connecting rod was taken adrift, when it was found that on testing the remaining bolt with a straightedge it was perfectly true and also had not developed any cracks after its unusual experience. I. S. N.

A Condenser Overhaul

The cylindrical condenser of a certain side-wheel steamer was found to be leaking badly, which on examination proved to be due to a large horizontal crack near the top of one of the tube plates. The only cause which seems probable is unequal expansion and contraction of the plate setting up strains which ultimately developed into a crack. No doubt there was some



MICRO-PHOTOGRAPH OF FRACTURED PORTION OF CONDENSER TUBE

flaw in the plate at the crack which would account for it starting in that particular plate. The only remedy for this was to fit a new tube plate, so the tubes were drawn.

It was observed that many of the tubes broke in the process of withdrawal, showing a brick-red fracture surrounded by a thin film of yellow brass. The appearance is shown in the accompanying micro-photograph. The thin white strip which formed the outer layer was approximately of the original composition of the tube, namely: 70 percent copper, 30 percent zinc, while the thicker and darker portion forming the inner layer was composed mostly of a spongy mass of almost pure copper. The magnification is 7½ diameters, and the photograph is unique in its way, being, so far as the writer is aware, the only one showing the outer and inner layers of brass and copper.

The explanation of the disappearance of the zinc from the alloy is not far to seek. Consider the parallel case of a galvanic battery, consisting of two simple elements immersed in an electrolyte and connected by a wire. We get a current of electricity from such a cell but at the same time one of the elements is destroyed. If this reasoning is applied to a condenser tube immersed in sea water it will be seen that the two cases are similar. The tube is a mixture of two elements, copper and zinc, and is immersed in an electrolyte consisting of sea water. The two metals with the sea water form a series of minute galvanic cells, which results in the destruction of the zinc.

The above case is typical of many, and as yet no remedy has been found which will prevent the removal of the zinc. The corrosion committee of the Institute of Metals have just brought forward their second report, presented by Mr. G. D. Bengough and Mr. R. M. Jones. As the result of their experiments these gentlemen suggest using an alloy of 70 percent copper, 29 percent zinc, 1 percent tin (Admiralty alloy), or 70 percent copper, 28 percent zinc, 2 percent lead (Muntz's special brass), instead of the usual standard 70 percent copper, 30 percent zinc alloy. Two other most important suggestions are that more use should be made of electrochemical means for retarding corrosion, and that the temperature conditions should be carefully looked after. CLYDE.

Collision of the Colmar and Mavis

A collision between the *Colmar,* of the Deutsch-Australisch Dampfgesellschaft, and the *Mavis,* of the General Steam Navigation Company, took place in the new waterway near Rotterdam on the morning of Sept. 17. The *Colmar,* which is a cargo steamer of 6,000 tons, 460 feet long, was beginning a voyage from Rotterdam to Australia, and in proceeding

THE SUNKEN MAVIS

through a thick fog ran into the port side of the *Mavis,* a new steamer running between London and Rotterdam. One passenger on the *Mavis* was killed by the collision and another was seriously injured. The *Mavis* sank within half an hour, and her crew was taken off by the *Colmar,* which steamed back to Rotterdam, where she was unloaded and docked for repairs.

The Batti Wallahs Society

Sea-going electrical engineers have their own peculiar troubles which have to be experienced in order to be realized, and it is therefore only the adjustment of the balance that on shore they manage to arrange for themselves an uncommonly good time. It is a striking testimony to the efficiency of the education which an electrical engineer on board ship receives, that many of the most important electrical engineering positions on shore are filled by men who have at one time or another in their career coaxed a balky bearing through the Red Sea, or traced the wandering ampere from the ship's dynamo to the hull where it ought not to be. Even when the perils of the sea are past, and the former sea-going electrical man has settled down to the enjoyment of emoluments and other pleasures of paradise on land, he does not forget the smell of the salt sea, and foregathers when occasion arises with the men who have been through the mill with himself.

In this way a most interesting society was instituted in 1906 in Great Britain which is known as the Batti Wallahs Society. It owes its backbone of membership to former electrical engineers of the Peninsula & Oriental Line who have now settled on shore, and who still retain a lively interest in marine electrical engineering, in each other, and to a limited and decorous extent in each other's wives and daughters. As a result of this the society has instituted during the winter a very festive concert season, each season including a couple of evenings in which the performers are only dimly seen through a haze of smoke, other evenings, which are labeled "informal," the title being quite correct, a dinner and annual general meeting. In addition to this the society publishes a quarterly journal, which is perhaps among the crispest literature extant, the talent of the Batti Wallahs evidently running very strongly in the direction of original sketches and still more original poetry. During the summer, among other festivities, a yachting cruise was arranged for the water Wallahs in a converted barge (this term is not used in a religious sense) known as the *Alde*.

Some idea of the incidental features of these summer trips may be obtained from an account for which we are indebted to Mr. H. J. Greenly, the honorary secretary of the entertainment committee of this society. The first summer function was a down-river trip from the Temple Pier in London to Canvey Island. Last year and this the society was singularly unfortunate in choosing their weather, and last year the motor boat used nearly foundered, and were it not for the fact that the Batti Wallahs on these trips are good navigators, something unfortunate might have happened. This year, on the same trip, they managed to knock a hole in the vessel by hitting some floating wreckage, but the accident was not discovered until the fly-wheel of the engine was throwing water up like a catherine wheel. The engine kept going until more than half submerged, and with the aid of the floor boards, which by that time were floating around those members of the society who were on board, the vessel was paddled sufficiently in-shore to feel bottom with a boathook before she sank. Except for a few heavy goods which had to be jettisoned, everything was salved, including the members and the boat.

Another annual event is the up-river trip to the beauty spots of the Thames, which is always a great success, about seventy ladies and gentlemen being on board during the present year's trip. Other similar trips are provided, but the chief feature is the cruise in the *Alde*, which is owned by the president of the society, Mr. Walter Riggs. The barge carries grain round the coast except during the time which it is being used as a pleasure yacht, and in order to fit it up for the purpose of the society some simple alterations are necessary. The well-known firm of British electrical engineers, Messrs. Siemens Bros., presented the society with the lamps, fittings and shades; another firm, Messrs. Pooley & Austin, provided them with a new 3½-kilowatt kerosene (paraffin) engine and generator, including switchboard and rheostat, while Messrs. Simplex Conduits provided the necessary cable and a Dutch oven type of electric cooker, together with a large grill, hotplate, toaster and two kettles. The batteries were used for lighting, and the cooking was done direct from the dynamo, half a pint of kerosene (paraffin) being sufficient to cook breakfast for sixteen.

The official Batti Wallah barge trip was from Friday before August Bank Holiday (the first Monday in August) to the following Monday week, a period of eleven days, inclusive. The start was made from North Woolwich on the Saturday, and Sheerness was reached on the first day, from there on to Harwich and Ipswich, and to Lowestoft, or Aldeburgh, returning to Brightlingsea and Burnham-on-Crouch, and occasionally to Margate and Ramsgate. The question of direction depends on wind and tide. On board a chart and log books are kept. On the chart is marked the course of each day's sailing, and a regulation log is kept of wind, tides, distance traveled and other information of interest to enthusiasts.

Altogether the Batti Wallahs manage to enjoy themselves very well, and the society has the purpose of knitting together in social intercourse men who would otherwise drift apart and forget the call of the sea. It would be a very useful thing if electrical engineers in the United States could follow some similar programme, as it would have the double value of providing social enjoyment and of providing a nucleus of concerted action in the many pressing problems which are attendant on the conditions of work of the sea-going electrical engineer. S.

"Hand Drilling"

In an article on "Hand Drilling" by Mr. A. L. Haas in the August issue, the writer notices the following statement: "The downward pressure needed for a 1-inch twist drill to be approximately 4 tons."

This statement appeared to the writer to be open to criticism, and the following are certain reasons which led the writer to believe that this figure is overestimated: It is possible, of course, that a pressure of four or even more tons might come on a 1-inch drill were the drill not in good condition; but given a drill properly sharpened it would appear that a 1-inch hole could be bored with considerably less pressure than that stated in the article.

The writer turned his attention first to the ordinary column drill, and considered whether it would be possible to raise, with the hand gear provided, a weight of 4 tons placed on top of the spindle. It did not seem reasonable to assume that, and yet a 1-inch hole can be bored by using the hand feed; in fact, if the automatic feed be shut off quickly, and the hand feed tried, it will be found that (provided the drill is in good condition) the drill may be fed in an appreciable distance beyond that which the automatic feed has given it.

Consider now the case of a portable electric boring machine, the type of machine that is now employed in many cases where a ratchet was formerly used. The writer recently had occasion to bore some 1-inch holes in wrought steel with an electric machine and a 1-inch Morse twist drill. The machine used had a ⅝-inch Whitworth screw fitted with a sleeve provided with a small cross handle for feeding in the drill. The drill was fed in by revolving the sleeve by hand, no great effort being required to make the drill take a good cut. Now the writer is sure everyone will admit that it is impossible to put a pressure of 4 tons on a ⅝-inch Whitworth thread screw.

Consider, now, the case of an ordinary ratchet brace, such as described by Mr. Haas in his article. The writer has found it possible to bore 1-inch holes, using an ordinary lip drill, by turning the box of the ratchet by hand, yet it is impossible to raise a weight of 4 tons by this means.

The above are the main reasons why the writer considers the pressure stated in the article overestimated. "ISON."

Glasgow.

Marine Articles in the Engineering Press

Shallow Draft River Boat St. George.—This boat was built by the Ailsa Shipbuilding Company, Ltd., of Troon, to the order of the Foreign Office for government service on the Congo. It is 110 feet long with a draft of 3 feet, and was built in three sections to facilitate transport to and erection in West Africa. An upper deck is fitted with four cabins and a dining saloon for accommodating passengers. Propulsion is by three sets of 76 brake horsepower British Kromhout oil engines, driving three propellers. The engines run on petroleum, a sufficient supply being carried for a trip of 3,000 miles. 9 illustrations. 450 words.—*Engineering,* October 31.

Typical Ships, No. III. A Steam Yacht.—Some idea of the many possibilities which are open to the architect in the design of a steam yacht, as well as the great variety of conditions which may be imposed by the owner, is pointed out to show the many features which will outline the size, type and characteristics of a steam yacht. As an illustration, a very thorough description is given of the *Sapphire,* designed by Messrs. G. L. Watson & Co., of Glasgow, and built by John Brown & Co., Ltd., of Clydebank, for the Duke of Bedford. The yacht is 251.4 feet long, 56.15 feet beam and 18.15 feet depth, with a Thames measurement of 142 tons. She is of conventional type propelled by a pair of four-crank triple expansion engines, the cylinders of which are 18, 29, 32 and 32 inches diameter, with a stroke of 27 inches. Steam is supplied at a pressure of 180 pounds by two three-furnace single-ended Scotch boilers and one smaller boiler for auxiliary purposes. Running at 169 revolutions per minute, the engines develop a combined horsepower of about 3,400, which gives the yacht a maximum speed of just over 15½ knots with forced draft. A cruising speed of 13 knots is obtained under natural draft. 11 illustrations. 4,000 words.—*The Engineer,* November 7.

The Twin Screw Passenger and Cargo Steamers Gablonz and Marienbad.—Destined for the Austrian-Lloyd mail, passenger and cargo service from Trieste to Bombay, these sister ships have been completed recently by the Cantiere San Rocco S. A., of Trieste. The dimensions are: Length between perpendiculars, 450 feet; breadth, molded, 56 feet; depth, molded to upper deck, 31 feet 5 inches; draft, fully loaded, 25 feet; gross tonnage, 8,450; speed, fully loaded, 16 knots; indicated horsepower, 7,500; capacity for cargo, 209,700 cubic feet; number of passengers, 150 first class, 30 second class, 100 third class. Each vessel has six decks, with the passenger accommodation all situated above the upper deck, the spaces beneath that deck being devoted to cargo and the machinery. Subdivision is by ten main transverse watertight bulkheads, extending to the upper deck, or to a height of 6½ feet above the maximum load line. Further subdivision is provided by a double bottom between the peak bulkheads. The article gives a detailed description of the passenger accommodations, illustrated by a number of excellent photographs. The electric plant consists of three turbo generators, capable of giving a continuous output of 200 kilowatts at 100 volts when the generators are running at 3,000 revolutions per minute. The cargo handling gear consists of four derricks at each hatchway attached to derrick posts and arranged to be used in pairs, one derrick being placed over the hatch and the other over the side, the lifted weight being transferred from one to the other by means of running tackle controlled by a double-barreled winch of Sieurin's latest type. One winch is supplied for each pair of derricks, the capacity of each derrick being 2½ tons. Propulsion is by twin screws driven by two sets of quadruple expansion engines with cylinders 26, 37, 53 and 76 inches in diameter, respectively, with a stroke of 51 inches. The machinery was built by Stabilimento Tecnico, of San Andrea, Trieste. Steam is supplied at 215 pounds pressure by eight single-ended cylindrical boilers, operating under Howden's system of forced draft. The total heating surface is 18,880 square feet, and the grate area 473 square feet. Details of the auxiliary machinery are enumerated, and the machinery arrangement is illustrated by line drawings. On a twenty-fours' trial the *Marienbad* maintained a speed of 16.2 knots with the engines running at 86 revolutions per minute and developing about 7,600 indicated horsepower. 20 illustrations. 2,500 words.—*The Shipbuilder,* November.

Electric Equipment and Concrete Construction at Auckland Harbor.—The harbor at Auckland carries so large an amount of shipping that the available wharves must be kept permanently ready for service. Destructive elements, such as tides, wind and marine life, compelled the replacement of short-lived wooden wharves by durable long-lived ferro-concrete structures. Horse and cart congestion, the handling and re-handling of cargoes in the narrow ill-lighted sheds, compelled the introduction of overhead and portable electric cranes, electric capstans and motors and efficient clusters of high power electric lamps. In the earlier wharves, a single line of sheds ran down the center of the wharf and the ships discharged into these from either side, while carts were permitted to enter the sheds for the purpose of loading or unloading. All moving of cargo within them was done by hand, in spite of the fact that the height was well over 8 feet, which is usually regarded as the official limit for manual tiering. These conditions resulted in congestion and delays, so that a new scheme was adopted in the general arrangement of the new wharves. A double row of sheds either one or two stories high, separated by a 60-foot roadway, extends the length of the wharves, the sheds themselves are 60 feet wide and have a 30-foot quay running along their outer sides. On this quay are mounted portable revolving cranes which transfer freight direct from the hold of the ship to railway cars on the quay or to the pier sheds. No cranes with a lifting capacity greater than 5 tons have been installed, as heavier weights are handled by an 80-ton floating crane. Most of the cranes are semi-portal supported; that is, on one leg only upon the coping of the wharf, the other being carried on a crane rail on the eaves of the shed. The cranes are operated by electricity furnished from the municipal power station. Small cranes are used mainly for tiering inside the sheds, and are moved from place to place by hand. The large cranes are moved by electric capstans placed at convenient distances on the quays. For double-story sheds conveyors and lifts, electrically operated, are installed. 22 illustrations. 4,000 words.—*The Engineering Magazine,* November.

U. S. S. Cassin and Cummings.—By Henderson B. Gregory. The *Cassin* and *Cummings,* built by the Bath Iron Works, at Bath, Me., are two of the eight torpedo boat destroyers authorized in 1911. They are twin screw vessels, fitted with a combination of Parsons turbines and reciprocating engine and designed for a speed of 29 knots at a trial displacement of 1,010 tons, with the main turbines alone developing 16,000 shaft horsepower. The dimensions are: Length on load waterline, 300 feet; length overall, 305 feet 3 inches; beam, extreme on load waterline, 30 feet 3 inches; draft, 9 feet 3 inches; corresponding displacement, 1,010 tons. The armament consists of five 4-inch rapid fire guns and four 5.2 meter by 45 centimeter twin torpedo tubes, mounted on the main deck. Of the propelling machinery, the turbines are designed to run at 550 revolutions per minute when developing 16,000 shaft horsepower, and the cruising engine is designed to

develop 700 indicated horsepower at 270 revolutions per minute. The engines are arranged on two lines of shafting. On the starboard shaft is the main high-pressure ahead turbine, and a separate astern turbine. On the port shaft is the low-pressure ahead turbine, in which is incorporated the low-pressure astern turbine. Forward of the low-pressure turbine and fitted to the port shaft by a clutch is the compound cruising engine with cylinders 16 inches and 24 inches diameter and 18 inches stroke. The propellers are three-bladed, 7 feet 4 inches diameter and 6 feet 8 inches pitch, with a projected area of 25.375 square feet, a helicoidal area of 28.69 square feet and a disk area of 42.24 square feet.

Steam is supplied by four oil-burning Normand watertube boilers, arranged in pairs in two separate compartments. At full power they operate under an air pressure in the fire-rooms of about 5 inches of water. The working pressure is 260 pounds and the heating surface of each boiler 5,377 square feet. There are twelve oil burners of the Modified Bureau of Steam Engineering type, and the fuel oil system consists of two light service booster pumps, four heavy pressure service pumps; two oil heaters and the oil storage tanks in the forward and after holds, together with the necessary piping and fittings. The *Cassin's* trials were run June 24 to 28, 1913, on the Rockland (Me.) course. Twenty-six runs were made on the standardization trial at various speeds over the measured mile, giving the mean revolutions per minute of the propellers for speeds of 12, 15½, 24 and 29 knots, respectively, as 197.3, 259.2, 421.1 and 565. On a four-hour full-power trial a speed of 30.137 knots was obtained on a displacement of 1,011 tons, the engines developing 15,307 shaft horsepower. 4 illustrations. 8,800 words.—*Journal of the American Society of Naval Engineers,* August.

The Underwater Horizontal Hydraulic Ash Discharger on the U. S. Colliers Proteus and Nereus.—By F. P. Palen. Experience with apparatus for expelling ashes straight down through the bottom of a vessel has shown that ashes expelled in this way will find their way into the pump suctions located aft of the openings through which the ashes are expelled and cause serious wear in the pump cylinders, and also block up the ends of the condenser tubes. In order to overcome these serious objections, there has been developed at the works of the Newport News Shipbuilding & Dry Dock Company and installed on the U. S. colliers *Proteus* and *Nereus* a hydraulic ash discharger of the horizontal type for discharging the ashes through the side of the vessel below the waterline in locations where the ashes will drift clear of the pump suctions. The apparatus consists of a horizontal hydraulic jet which forces back the sea water and carries overboard the ashes which are introduced through a hopper at right angles to the hydraulic jet. The hydraulic jet is produced by an annular nozzle, so formed as to cause the conical shaped water jet to converge and form a solid stream beyond the end of the annular nozzle and then diverge into an ordinary hydraulic stream. The solid portion of the jet, where it passes through the contracted portion of the pipe beyond the discharger, forces back the sea water and creates a suction in the ash pipe forming the inside ring of the annular opening through which the discharge water passes. This suction drives whatever is contained in the ash pipe into the hydraulic system and carries it overboard. In actual operation on the *Proteus* the jet created a suction equal to 18 inches of vacuum when the cover of the ash hopper was closed. The water for the hydraulic jet is supplied at a comparatively low-pressure from a turbine-driven centrifugal pump. The jet operates when the water pressure at the jet is equal to or slightly greater than the head of water equivalent to the draft of the vessel. The jet works effectively with a pressure of less than 25 pounds gage. Other special features for the apparatus are a rotating ash valve which is operated by a small double cylinder engine that will start from any position. This valve is made with a hardened cast steel rotor and acts as a crusher, preventing pieces from passing that are too large to go around the bend in the ash pipe. The valve also serves to prevent any large inrush of water into the vessel in case the sea valves and hopper covers are left open when the pump is not running. A small jet of water is introduced into the bend in the ash pipe to assist the suction to carry the ashes clear of the horizontal portion of the ash pipe nozzle. There is no wear on the discharge pipe, as the ashes are carried out in the stream and at a speed sufficient to shoot them clear of the side of the vessel. The rated capacity of the discharge is from 12 to 15 tons per hour. 7 illustrations. 2,000 words.—*Journal of the American Society of Naval Engineers,* August.

The Polar Diesel Engine.—This is a continuation of a series of articles which the editors have presented on the Diesel engine, taking up the various types of engines built in Great Britain, Germany, Italy, Belgium, Holland, Switzerland, Denmark, France, the United States, Sweden and Russia. All of these have been described previously except the engines built in Sweden and Russia. The present article is devoted to the various types of Diesel engines built by the Aktiebolaget Diesels Motorer, Stockholm, Sweden. This firm claims to have constructed the first reversible Diesel engine and has now been regularly constructing this type of engine for marine purposes since 1907. Twenty-seven sets have already been actually fitted on board ship, varying from 60 to 260 horsepower, while not less than twenty-nine sets are under construction, the maximum power having advanced to 1,650 in six cylinders. A radical departure in the Polar Diesel engine is in the arrangements for starting and maneuvering. In this engine the scavenge pistons are temporarily diverted from their duty and converted into an independent two cylinder double-acting starting engine. The article is the result of personal observation and investigation, and presents in detail the various features of the engine and its operation. 11 illustrations. 5,500 words.—*The Engineer,* October 24.

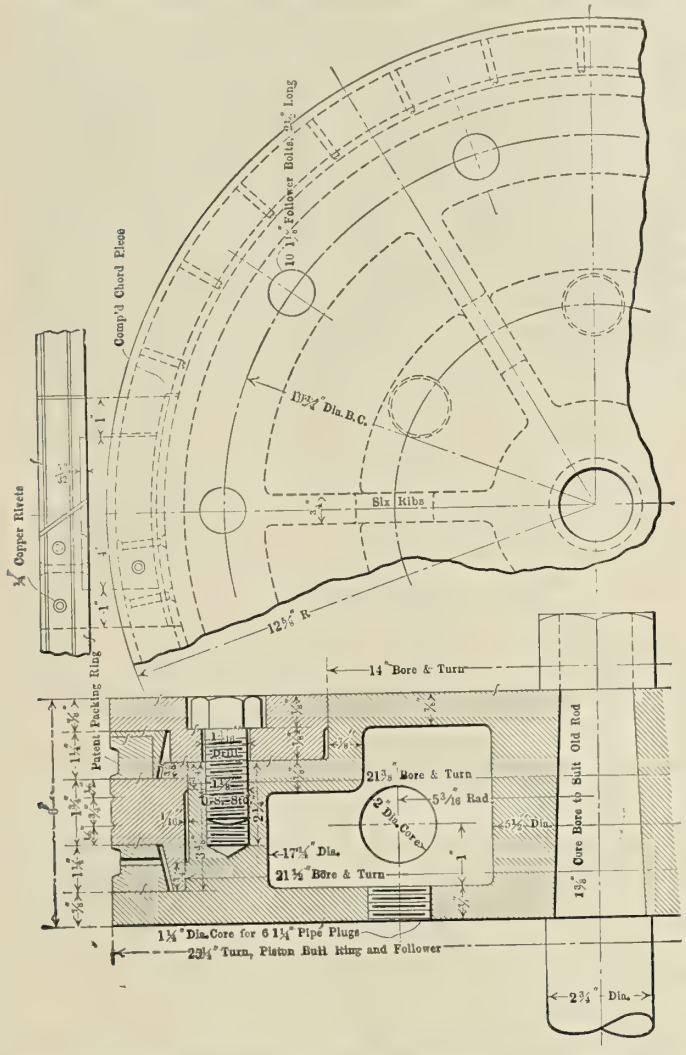
U. S. Fleet Collier Jason.—By Henderson B. Gregory. The U. S. collier *Jason,* authorized in 1911 and built by the Maryland Steel Company, of Sparrows Point, Md., has a speed of 14 knots at about 19,130 tons displacement, with the main engines developing about 6,800 indicated horsepower. The dimensions are: Length overall, 536 feet; length on waterline, 514 feet; beam on load waterline, 65 feet 2½ inches; draft, 27 feet 4½ inches; corresponding displacement, 19,130 tons. Propulsion is by two triple expansion engines with cylinders 27, 46 and 76 inches diameter and 48 inches stroke, designed to develop 6,800 indicated horsepower at 90 revolutions per minute. Steam is supplied at 200 pounds pressure by three double-ended Scotch boilers, 16 feet 1 9/16 inches diameter and 21 feet 4⅝ inches long, with 6,307 square feet of heating surface and 146.7 square feet of grate surface. The standardization trials were run over the Delaware Breakwater measured mile on June 18, showing that it required 93.1 revolutions per minute of the main engines to give the contract speed of 14 knots. On the twenty-four hour full-power trial, with a mean draft of 27 feet ½ inch and a corresponding displacement of 18,862 tons, the engines developed 6,878 indicated horsepower at an average of 95.2 revolutions per minute, giving a mean speed of 14.322 knots. Tests of the coaling gear showed that 128 tons of coal could be discharged per hatch per hour. The fore-and-aft coal transfer gear was also tested, showing that coal could be transferred from the after hatch to the forward hatch at the rate of 72 tons per hour. 1 illustration. 2,000 words.—*Journal of the American Society of Naval Engineers,* August.

U. S. DESTROYER HENLEY.—On her final speed trials off Sandy Hook, N. J., Nov. 17, the United States torpedoboat destroyer *Henley,* built by the Fore River Shipbuilding Company, Quincy, Mass., attained a speed of 30.3 knots, or an increase of .8 knot beyond contract requirements.

ENGINEERING SPECIALTIES

The R. C. Monteagle Packing for Pistons and Piston Valves

The purpose of the R. C. Monteagle packing, which is manufactured by the Lockwood Manufacturing Company, East Boston, Mass., is to prevent leakage around pistons and piston valves where steam, water, air, ammonia or gas is used, and to do this with practically no friction. The packing is usually made with two floating packing rings and a bull ring to center and guide the piston. The construction, as applied to a piston,

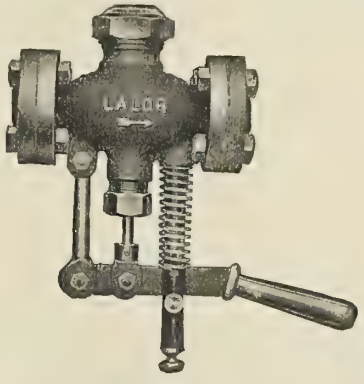


is shown in the illustration. The ring, it is claimed, is tight for an indefinite period of time; does not "slap"; runs practically without friction and therefore with a minimum of wear. These highly desirable results are obtained by cutting the rings angularly at the back, as shown in the illustration. It is well known that steam finds its way back of the ring, and as there is an almost constant pressure in this space the rings are not only held out against the walls of the cylinder but against the follower and piston flange as well, cutting the leakage down to a minimum. Any steam which may pass the first ring is stopped by the second. Carefully fitted "chord pieces," or joint breakers, are fitted to each ring. The principal claims made for these packing rings are that they are tight under the most severe conditions of service; they operate with minimum friction, as they are practically balanced; they cause little wear to cylinders or pistons; they are suitable for either high or low-pressures, ranging from vacuum to 1,000 pounds; they adjust themselves automatically to the variable pressures encountered in all cylinders; they are suitable for steam, air, water or ammonia, and they give a high efficiency, and hence greater economy in fuel.

This packing can also be applied equally well to piston valves. A case in point is that of an automatic high-speed engine with high-pressure and low-pressure piston valves on the same stem, the whole being operated by a shaft governor. The builders of this engine had been accustomed to omit rings in the valves, as they had been unable to design a tight valve with packing rings which would operate freely. The type of valve used was the "plug" valve, and when this was fitted with the new patent packing rings just described, it was found to operate not only as freely as before but an increase of power of over 30 percent was gained by the installation. There were eight rings in the combination valve, and it was found that the governor controlled the valves as sensitively as before the rings were applied, showing that friction was reduced.

Lalor Automatic Stop Valve

The Lalor automatic stop valve, manufactured by the Lalor Fuel Oil System Company, Philadelphia, Pa., was designed to prevent fire and loss of life in connection with the use of any burning liquids. It minimizes the danger which has hitherto attended the use of fuel oil by providing the equipment with positive valve control. The valve can be used in connection with various oil-burning systems, such as steam boilers, heating and tempering furnaces, rivet forges, portable torches and



gas retorts. The valve has been placed on the approved list of the Underwriters' Laboratories and has also been approved by the United States navy.

This automatic stop valve has a distinct feature, in that all the working parts are submerged, and they are therefore not subject to the action of the air, and, consequently, corrosion is prevented. Furthermore, the general design of the valve is such that the controlling forces acting on the plunger are greatly in excess of any friction that might possibly occur, so that the valve cannot fail to operate. The reliability of the valve and absence of failure are shown by a series of tests made on a number of these valves, where out of forty-six hundred fractures of various sizes the valves never had a single failure.

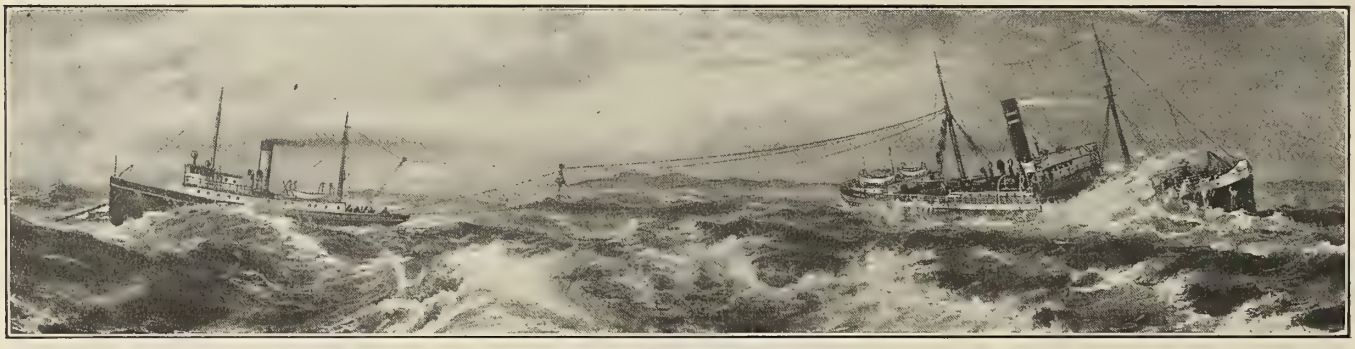
The complete Lalor system for safeguarding the use of fuel oil is composed of a master valve situated at the tanks or pressure means, group control valves for the pipe system and individual control valves which control the burner operation on each furnace. A test of a ½-inch individual control valve, made on a bolt-heating furnace, prevented the operator of that furnace from drawing more oil than the furnace could properly consume, and when the operator attempted to throw open the ½-inch needle valve, the flow of oil was checked with a loss of only 2 ounces, and the fire was thrown not more than 12 inches beyond the furnace doors. A similar test, made on the same furnace but without the use of the automatic stop valve, showed that the fire was thrown for a radius of 35 feet.

The approval of the United States navy for this valve was obtained when one of the destroyers was equipped with a full system, which was given a thorough service test. Since then installations have been made on the battleships *New York*,

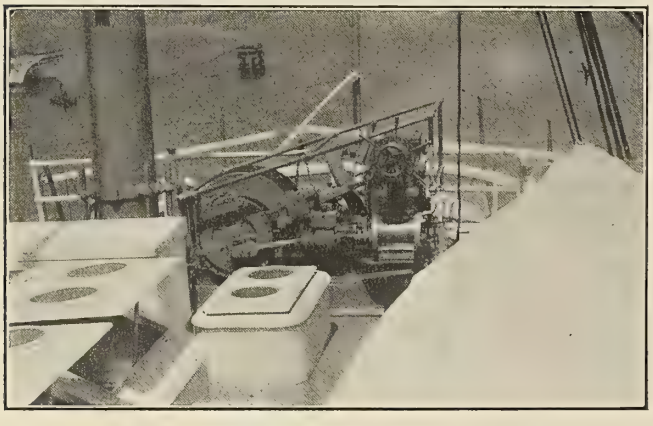
Texas and *Nevada*. In the merchant service, one of the recent vessels of the American-Hawaiian Steamship Company has also been equipped with this device.

Life-Saving Appliance

In view of the difficulties encountered in rescuing passengers from the ill-fated *Volturno* during a gale, attention is called to an apparatus which was installed several years ago on the United States revenue cutters *Acushnet* and *Snohomish*, and which has been used successfully in rescue work under trying conditions. On these vessels a Hall breech-loading line-throwing gun is provided, mounted upon a peculiar type of carriage that can be secured to the rail of the vessel at any point, and which can be accurately trained and fired without recoil trouble in a seaway, throwing a line with accuracy up to a distance of 2,000 feet. As soon as communication is established by throwing a line across the distressed vessel, tackle can be hauled on board and made fast to the mast by means of which a wire cable and breeches buoy can be passed to the wreck. The breeches buoy equipment installed on the revenue cutters mentioned is of the Spencer Miller type, in which the cable for the breeches buoy passes through a block on the mast head of the rescue ship to an automatic reel on the deck, operated by an automatic tension engine which constantly pays out and takes up on the main cable to compenstate for the motion of the ships. In this apparatus a haul-down block is provided so that the passengers in the breeches buoy can be landed directly on the deck of the rescue ship. An apparatus by which communication can be established between two ships at a safe distance apart in a rough seaway, and by which human beings can be transferred rapidly from one ship to the other in spite of the violent tossing of the vessels and the constantly varying distance between them, should be carefully considered by shipowners and government authorities as a possibility in life-saving equipment.



SPENCER MILLER BREECHES BUOY IN ACTION



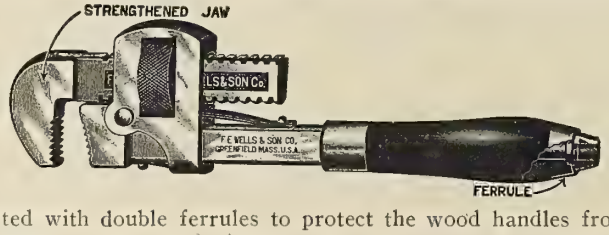
AUTOMATIC TENSION ENGINE

Testing of Lubricants

Rough-and-ready methods of testing lubricating oils to ascertain their suitability for various purposes are frequently misleading, and lacking a standard of comparison are of little practical value to the engineer. The Stern Sonneborn Oil Company, Ltd., London, E. C., has produced a comparatively simple and reliable apparatus, known as the Sternol oil testing machine, to be used for determining the value of lubricating materials under actual working conditions, with means of standardizing the results obtained. This machine, it is claimed, is capable of reproducing the exact working conditions of any machinery, steam, gas and oil engines, covering such items as load, speed, cylinder pressure, temperature, etc. By means of this apparatus the engineer is able to determine with certainty the suitability of an oil or grease for any given purpose and also to prepare charts showing the comparative efficiency of various qualities.

"Wells" Pipe Wrenches

F. E. Wells & Son Company, Greenfield, Mass., has on the market pipe wrenches with especially strengthened jaws and



fitted with double ferrules to protect the wood handles from breaking. The construction of the wrench is shown in the illustration.

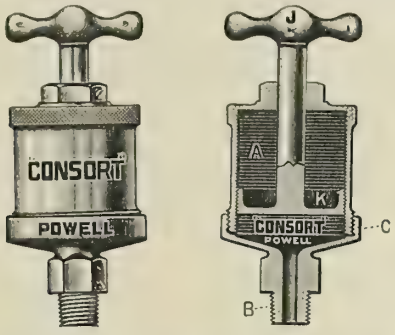
"Thread-Tight"

"Thread-Tight," manufactured by the Thread-Tight Company, New York, is a compound for making tight either screwed or flanged joints on high-pressure steam, ammonia or pneumatic lines, high-service hydraulic work, acid lines, gas piping or boiler caps, manholes, etc. It is claimed by the manufacturers that neither heat nor cold will affect the compound, and that it can be put on a wet surface, such as an iron pipe submerged in water, adhering to the wet surface as firmly as to a dry pipe. "Thread-Tight" does not become hardened in the joints, and therefore does not injure the thread when breaking the joints. It is used as a preservative for gaskets, preventing their deterioration, and the gaskets are readily removed should occasion arise.

Another compound known as "Gasoltite" is furnished by the same company. This compound is said to be gasolene (petrol) proof and of great value on account of its not hardening qualities in motor boat, automobile and engine service for threaded and flanged connections which have to stand gasolene (petrol). It is a lubricant for gasolene (petrol) plugs, valves, cocks, plungers, etc.

The Powell "Consort" Screw Feed Grease Cup with Screw Plunger Feed

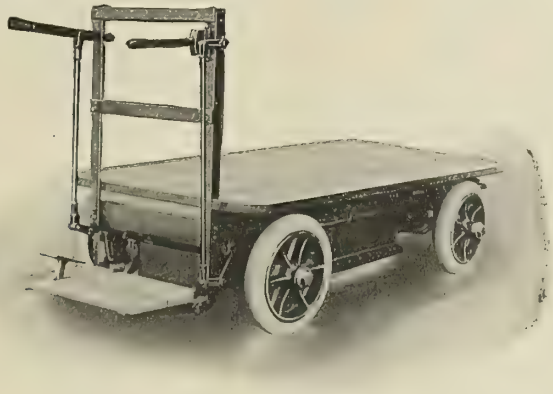
The Powell "Consort" screw plunger feed cup is manufactured by The William Powell Company, Cincinnati, Ohio, to meet the demand for a simple, cast brass highly finished grease cup. The most important feature of this cup and its advantage is that of being easily refilled, as the bonnet which carries the grease can be removed from the base for this purpose, the base



remaining in position. The cups are adapted for marine engines, air compressors and ice machines, and wherever it is necessary to force the grease some distance, being suitable for an intermittent or positive feed. The operation is simple. The threads in the bonnet and plunger are a close and snug fit, work freely, and with ordinary care will not permit the grease to crowd past. By screwing down the plunger the grease is forced to the bearing.

The Hunt Storage Battery Industrial Truck

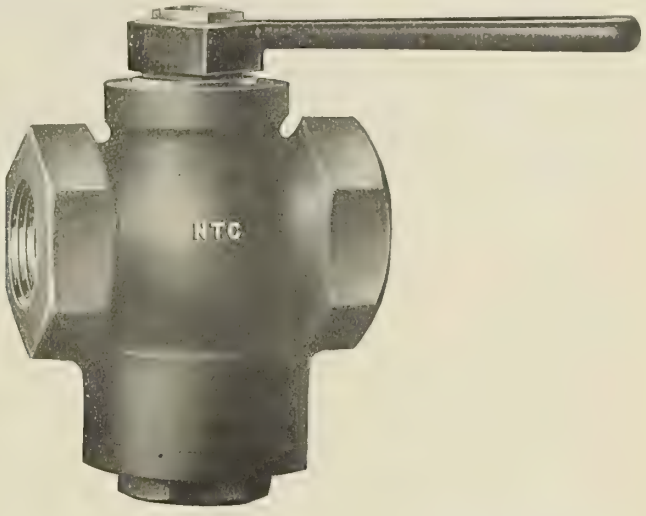
The Hunt storage battery industrial truck, built by the C. W. Hunt Company, Inc., of New York, is designed for conveying heavy material around manufacturing plants, shops and railroad terminals, etc., where it can be run with the utmost flexibility, put on elevators and conveyed to different floors, or run directly into box cars, all of which would be practically impossible with a system of tracks. These trucks are very compact and have a capacity of approximately 4,000 pounds.



With this load the maximum speed is about 5 miles per hour. The storage capacity of the batteries is ample for an ordinary full day's working. Either Edison iron and nickel cells or Exide lead cells are supplied. The storage battery cells are encased in a battery box of heavy steel, suspended by springs from the cross members of the frame. The entire section of the top of the truck over the battery box is removable, thus making the batteries readily accessible. The motor is especially designed for vehicle service, with storage batteries, and drives the wheels through a differential of cut steel gearing, all enclosed in an oil and dust-proof housing. Ball and roller bearings are used throughout. The operator's platform is at the front of the truck, as shown, from which the truck is steered by the right-hand lever. The other lever controls the motor, and the brake is actuated by the foot pedal. When not in operation the truck is always locked.

National Spring Plug Cock

The National spring plug cock, manufactured by the National Tube Company, Pittsburg, Pa., was designed to overcome the disadvantages of the ordinary style or through-plug cock. When the plug becomes loose in the ordinary type of



cock, the workmen frequently injure the plug in tightening it. Also, if the plug becomes cemented to the body, it is common practice to loosen the nut and drive up the plug with whatever tools are at hand, no special care being taken to properly adjust the plug afterwards. The National spring plug cock on the other hand has an inverted plug with a spring at the bottom, which constantly presses the plug firmly against the seat. While the plug usually turns easily, if for any reason it should stick it may be loosened by a blow on the top, after which it is immediately reseated by the spring. The cap at the bottom is screwed secure into the body and cannot be tampered with by the workman. These cocks are tested to 250 pounds cold-water pressure and to 125 pounds compressed air pressure under water, and are recommended for 125 pounds working pressure.

SWEDISH DIESEL ENGINES TO BE MANUFACTURED IN AMERICA.—A new corporation, known as the McIntosh & Seymour Corporation, has just been formed with a New York State charter to engage in the manufacture, on an extensive scale, of a full line of Diesel engines, both stationary and marine. The company, which is backed by American interests and also to a large extent by Swedish capitalists who now control the Swedish Diesel Motor Company (Aktiebolaget Diesels Motorer), has taken over the plant and organization of the McIntosh & Seymour Company of Auburn, N. Y., builders of high-grade steam engines. The present steam engine business will be continued as heretofore, with the addition of the construction of Diesel engines, built on the Hesselman system.

LAUNCH OF THE FIONIA.—The motor ship *Fionia*, under construction by Burmeister & Wain, Copenhagen, for the East Asiatic Company, was launched Oct. 11. The vessel is 414 feet long over all; 395 feet long between perpendiculars; 53 feet breadth; 30 feet depth from awning deck; 24 feet 3 inches draft, with a dead weight capacity of 6,700 tons. The propelling machinery, consisting of two 6-cylinder Diesel engines, with a total of 4,000 indicated horsepower, will give the ship a speed of 13½ knots.

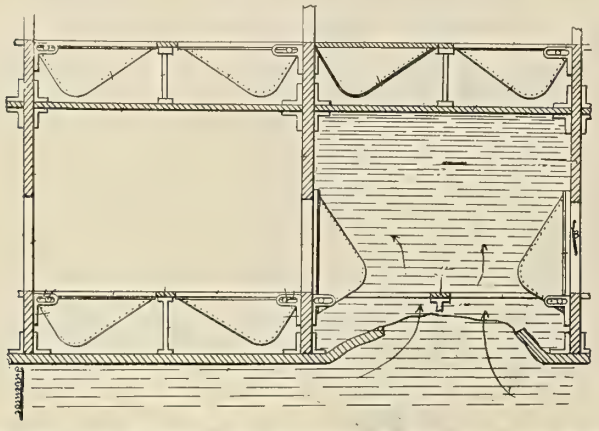
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

1,071,845. SELF-CLOSING COMPARTMENT DOORS. WILLIAM P. WILBER OF PROVIDENCE, R. I.

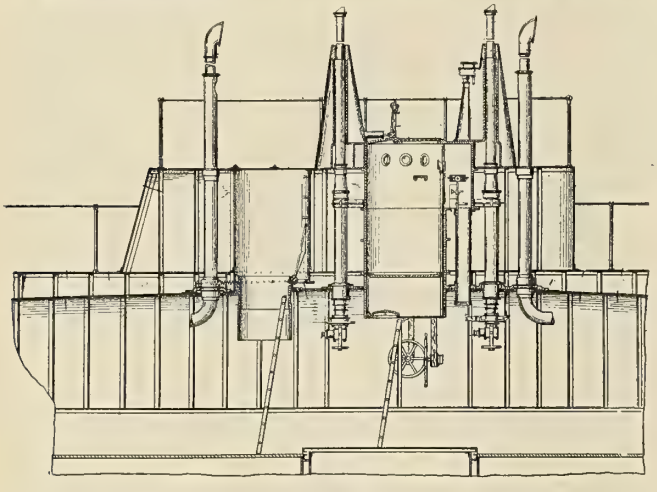
Claim 1.—The combination with a ship divided into a number of communication compartments, of self-closing doors for the same, said doors being hinged to the side walls of the compartments and forming, when in



their open position, bottoms for the same, and air tanks carried by said doors, whereby an inflow of water will move the doors to a vertical position, at which time the compartment will be cut off from communication with the adjoining compartments. Two claims.

1,072,393. SUBMERSIBLE-BOAT CONSTRUCTION. LAWRENCE Y. SPEAR AND HUGO E. GRIESHABER OF NEW LONDON, CONN.

Claim 1.—In a submersible vessel, the combination with a watertight hull constructed to withstand the pressure of deep submergence, and an upstanding observation tower also constructed to withstand such pres-



sure, of upstanding periscope tubes and ventilators outside of said tower, and a self-bailing and self-filling housing shaped to constitute a fairwater about said tower, periscopes and ventilators. Ten claims.

1,072,392. CONSTRUCTION AND CONNING EQUIPMENT FOR SUBMERSIBLE BOATS. LAWRENCE Y. SPEAR AND HUGO E. GRIESHABER OF NEW LONDON, CONN.

Claim 2.—In a submersible vessel, a conning tower having a periscope at one end thereof, an additional periscope extending down within the hull of the vessel at the same end of the conning tower, and a fairwater on top of the conning tower about the two periscopes. Four claims.

British patents compiled by G. E. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton Building, W. C., London.

9573/1913. AN IMPROVED METHOD OF OR MEANS FOR STABILISING SHIPS. W. J. DICKINSON OF URMSTON, NEAR MANCHESTER.

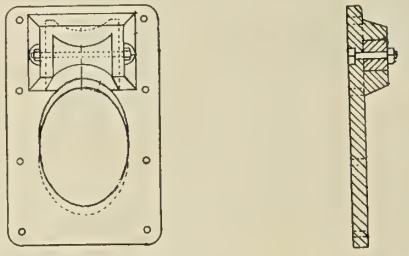
Claim.—For stabilising ships by means of a power-driven blower in communication with the various compartments of the ship by valve-controlled pipes through which pressure air can be led to drive out or prevent further influx of water resulting from a fracture of the hull of the vessel below the water line, the present invention consists essentially in the provision of turbo or other high-pressure blowers with or without a generator directly attached, and conduits leading from the blowers to the number of compartments required by automatic valve arrangements.

16,717/1912. IMPROVED APPARATUS FOR CLEANING THE HULLS OF SHIPS. F. G. BROWNE OF MALVERN, NEAR MELBOURNE, VICTORIA, AUSTRALIA.

Claim.—This invention relates to an improved apparatus for cleaning the hulls of ships or any kind of vessel, in which a cleaning device is suspended from a derrick mounted on a floating (or non-floating) punt or support separate from the ship to be cleaned and the degree of pressure of the actual cleaning member or members against the ship's hull is adapted to be regulated either entirely by the cables, chains or the like, by which the cleaning device is suspended, being adjusted relatively to one another, or partly by the relative adjustment of the cables, chains or the like and partly by means adjustably mounted on the cleaning device.

25,393/1912. AN IMPROVED SHIP'S HAWSE PIPE COVERING PLATE. W. F. P. SMITH AND D. T. REES OF BARRY DOCK, GLAMORGAN.

Claim.—This improvement in ship's hawse pipe covering plates consists in the provision of a renewable wearing surface in the form of a



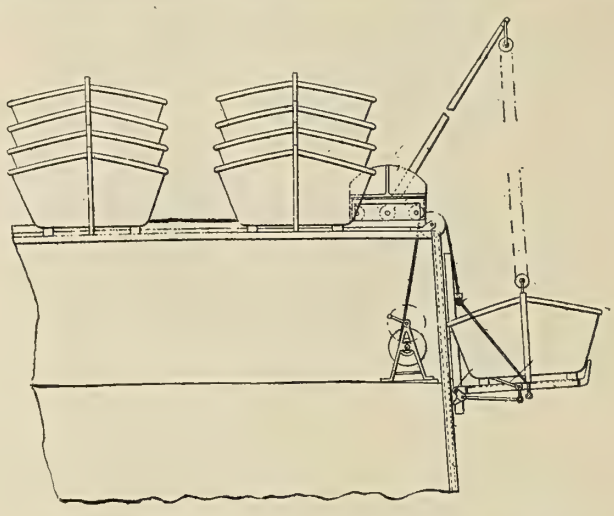
renewable block adapted to be fixed in a three-walled recess formed on the plate by a transverse pin or by a pair of bolts.

8,740/1913. AN IMPROVED ANCHOR. W. WENIGER OF PITSMOOR, SHEFFIELD.

Claim.—To obviate the use of loose trunnion pins, blocks, securing pins, etc., which take the back kick of the shank of an anchor, the head and fluked arms are formed of a single casting, the head being cored out to receive the shank and its integral trunnion, which turns on shoulders in the head, while the crown of the head is struck with such a radius from the center of the trunnion as will allow the crown to swing clear of the band (on the shank), which takes up the back kick of the shank, it being either shrunk, bolted or otherwise secured to shank just clear of the swinging head.

18,662/1912. IMPROVEMENTS IN MEANS FOR LAUNCHING SHIPS' BOATS. G. SCHULTZ OF BUSH LANE, LONDON.

Claim.—Relates to the launching of ships' boats, the invention being applicable for enabling passengers to enter or leave ships, for loading and unloading same, etc. Davits traveling on carriages, on rails on the



deck, are provided for bringing the boats to the side of the vessel and lowering them on to a grid which is pivoted to a carriage capable of sliding in grooves on the ship's side and upon which the boats are lowered, suitable tackle being provided for this.

17,984/1912. IMPROVEMENTS IN LIFEBOATS OR RAFTS IN COMBINATION WITH THE METHOD OF LAUNCHING THE SAME. J. MACNAB OF ISLINGTON, LONDON.

Claim.—This invention relates to an improvement in apparatus for launching boats from ships' decks in which a slip-way down which the boat slides engages at its rear end in guides upon the ship's deck and is adapted to be projected until its whole length extends over the ship's side, when the front end is lowered, hauling gear being provided for maintaining the slip in the plane of the guides until fully projected and then lowering its front end. A pinion engages a rack upon the slip for projecting it outwards or for returning it to its position upon the deck.